LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERIES
INVESTIGATIONS

Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch) and published by favor of the Honorable the Premier.

THE CRUSTACEANS

OF

SOUTH AUSTRALIA.

By HERBERT M. HALE,

Zoologist, South Australian Museum.

Part I.

WITH ILLUSTRATIONS.

[Wholly set up and printed in Australia, and registered by the Postmaster-General for transmission through the post as a book].

Price: FIVE SHILLINGS.

COPYRIGHT

ADELAIDE:

PRINTED BY HARRISON WEIR, GOVERNMENT PRINTER, NORTH TERRACE.

1927.

HANDBOOKS ISSUED AND IN COURSE OF PREPARATION.

*The Building of Australia and the Succession of Life, with special reference to South Australia Part I. (Price 5s.)	Walter Howchin, F.G.S.
The Building of Australia, etc. Part II.	do.
*Flora Part I. (Price 3s.)	J. M. Black (Orchidaceae R. S. Rogers, M.A., M.D.)
*Flora Part II. (Price 5s.)	J. M. Black.
*Flora Part III. (Price 5s.)	do.
Flora Part IV.	do.
Types of Vegetation in South Australia	T. G. B. Osborn, D.Sc.
Seaweeds	Edith M. Osborn, M.Sc.
Plant Pathology	Geoffrey Samuel, M.Sc.
Toadstools and Mushrooms	J. B. Cleland, M.D.
Molluscs	Sir Joseph Verco, M.D., F.R.C.S.
Spiders	R. H. Pulleine, M.B.
Beetles	Arthur M. Lea, F.E.S.
Butterflies and Moths	Norman B. Tindale.
*Crustaceans Part I. (Price 5s.)	Herbert M. Hale.
Crustaceans Part II.	do.
†Fishes (Price 6s.)	Edgar R. Waite, F.L.S., C.M.Z.
Reptiles and Amphibians	do.
†Mammals Part I. (Price 4s.)	F. Wood Jones, D.Sc.
†Mammals Part II. (Price 4s.)	do.
†Mammals Part III. (Price 5s.)	do.

Parts issued are marked *

Completed subjects are marked †

NMFS Honolulu Library
00000000002361

Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch) and published by favor of the Honorable the Premier.

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY

THE CRUSTACEANS

OF

SOUTH AUSTRALIA.

By HERBERT M. HALE,
Zoologist, South Australian Museum.

Part I.

WITH ILLUSTRATIONS.

[Wholly set up and printed in Australia, and registered by the Postmaster-General for transmission through the post as a book].

Price: FIVE SHILLINGS.

COPYRIGHT.

ADELAIDE:
PRINTED BY HARRISON WEIR, GOVERNMENT PRINTER, NORTH TERRACE.

1927.

857[60]

B, L'AAIN
.H13
V.1

AUTHOR'S PREFACE.

It has been recently remarked that the majority of people hardly yet realize that, in studying the teeming life of the ocean, we are investigating the principal food resources of a not far distant future, when the fruitfulness of the land will no longer be able to supply the needs of an overgrown human population.

When this source of food supply is more widely utilised, much biological research will be necessary in order to discover means of maintaining an increasing supply of the desired products, for constant and indiscriminate toll of certain forms will surely lead to their ultimate extinction. Already the depletion in numbers of the rock-lobster, or crayfish, of the southern coasts of Australia is causing some anxiety.

Indispensable parts of comprehensive biological research are the assignment of animals to their proper divisions, and the naming, describing, and cataloguing of them, so that they may be easily recognized. At the present time the study of the structure and relationships of marine creatures is the primary business of zoologists dealing with the oceanic faunas.

When shown an unfamiliar animal or plant many people, both civilized and savage, first ask, "Is it good to eat?"; secondly, "Is it of any use?" In dealing with any group of animals, we should come to a sorry pass if we disregarded all which cannot be eaten, or which do not directly produce something useful to man, for the influence of some of the neglected creatures may seriously affect the animals we have regarded as economically important. For instance, it is stated that the food of the Greenland whale consists in the main of a crustacean, insignificant in size, but occurring in prodigious numbers. Certain crustaceans form at least part of the commisariat of food fishes, but, on the other hand, some are of no benefit to man, but adversely affect his food and his works. Some are parasitic upon fishes, and others are a source of considerable annoyance and expense owing to their habit of boring into the timber of jetties and other structures.

Records show that crustaceans attracted the attention of man in very ancient times. It is stated, for instance, that the little Pea-crab (*Pinnotheres*) appears in the hieroglyphics of the Egyptians. Almost all the Greek coins of Agrigentum, a State in Sicily, at about 550-287 B.C. bear the image of a crab on the reverse side, while in the coins of another State (Solus, 405-350 B.C.) a crayfish is depicted on the reverse in at least one case. The emblem, in 300-166 B.C., of Cos, Caria Islands, Asia Minor, was a crab, and this type appears on many of the coins of Cos. A denarius of Marcus Servilius and Caius Cassius Longinus, B.C. 43-42, shows a crab holding aloft an aplustre. This coin is said to record a victory of the last-named Roman in a fight which took place within sight of Cos. Later, an aureus of Marcus Durmius, B.C. 14, depicts on the reverse a crab holding a butterfly in its claws. A symbolical crayfish is shown on a denarius and on a quinarius of the Roman Republic.

Observations concerning Crustacea and other creatures were made by Aristotle (384-322 B.C.), and by his successors in the Middle Ages, but it is only during the last two centuries, particularly during the last century, that the study of animals has been extensively undertaken. Each year there are additions to the ranks of workers, and at present thousands of zoologists are investigating the fauna of the world.

Much remains to be written concerning the Crustacea occurring in South Australian waters, and it is hoped that this handbook will stimulate some interest in the group, and, at the same time, serve as a working basis for those desirous of studying these Arthropods.

In 1882 Professor Haswell's Catalogue of Australian Stalk and Sessile-eyed Crustacea appeared, and therein were included records of the few species then known to occur off our State. Other forms were described later, but no further complete list has been published. Since the promulgation of this catalogue four workers in South Australia, namely, Prof. Ralph Tate, Mr. A. Zietz, Mr. Walter H. Baker, and, more recently, myself, have interested themselves in our Carcinological fauna. Occasional records of crustaceans from South Australia are also to be found in the works of Drs. Schioedte and Meinert, Dr. Collinge, Dr. Chilton, Dr. Rathbun, Mr. A. R. McCulloch, and others.

In dealing with the crabs, I am indebted to my friend, Mr. F. A. McNeill of the Australian Museum, who has compared South Australian representatives of various species with Prof. Haswell's types and other specimens. I wish to tender best thanks for his valuable assistance.

H.M.H.

Chapter I.—INTRODUCTION.

The Crustacea, as a whole, form one of the six classes of the great Phylum Arthropoda, which includes all those invertebrate animals which have a more or less firm, segmented exoskeleton (or outer shell) and jointed limbs or appendages, some of which are modified to operate as jaws. It is not an easy matter to briefly define the characters by which the Crustacea may be separated from their allies, for there is great diversity of structure and habit in the different groups. Concisely defined, the majority of crustaceans are aquatic animals, breathing by gills, or by the general surface of the

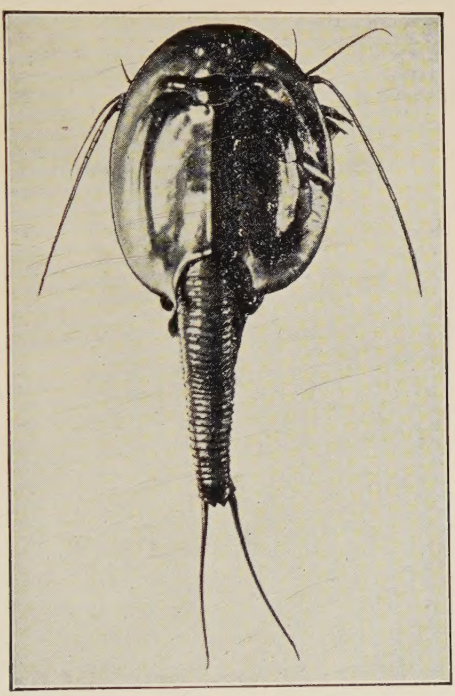


FIG. 1.—Shield shrimp.

body, having two pairs of feelers (or antennae) on the front part of the head, and at least three pairs of jaw appendages. The class Crustacea is divided into five subclasses, each of which is subdivided into two or more orders. These subclasses are termed the Branchiopoda, Ostracoda, Copepoda, Cirripedia, and Malacostraca. The South Australian species of Malacostraca (which is the largest and most important of the subclasses) are dealt with in detail in the following chapters, but it may be useful to very briefly mention here a few common representatives of the other subclasses. In the Branchiopoda there may be a carapace in the form of a bivalve shell, or a shield, or there may be no carapace; the Fairy-shrimps

(which swim upside down and have leaf-like feet), the Shield-shrimps, and the water-fleas of the genera *Daphnia* and *Estheria*, are familiar examples of the orders. These creatures are found in temporary rain-water pools, in rock-pools, dams, etc. The crustaceans of the subclass Ostracoda are enclosed in a bivalve shell; the species, which are usually tiny, occur in both fresh and salt water (fig. 2 c.). The fresh-water "flea" shown in fig. 2 d. is a representative of the Copepoda, the usually microscopic species of which occur in both the sea and fresh water: some much modified species live as parasites on fishes. The fourth subclass—the Cirripedia—embraces the Barnacles and Acorn-shells which are sometimes popularly confused with the Mollusca; mention must also be made of some remarkably degenerate barnacles which are parasitic on crabs. These degraded creatures are sac-like in form and may prove puzzling objects to those who encounter them for the first time (fig. 4).

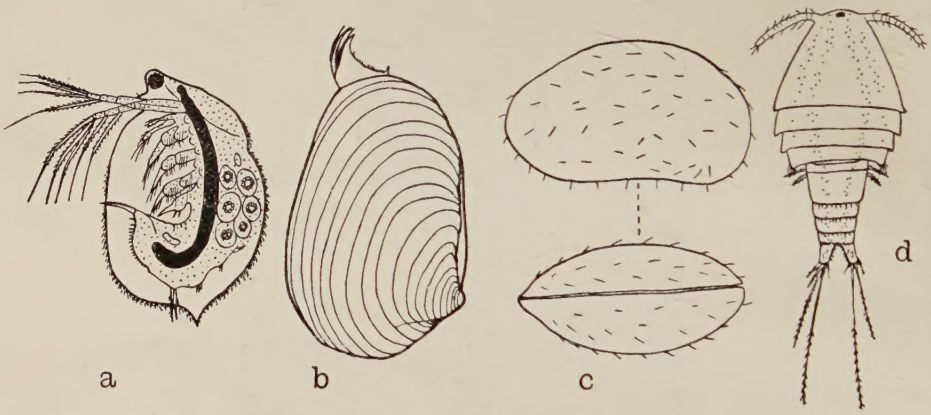


Fig. 2.—Water-fleas. a, *Daphnia* (x 28); b, *Estheria* (x 6); c, lateral and dorsal views of *Cypridopsis* (x 55); d, *Platycyclops* (x 38) (partly after M. Henry).

Nomenclature and Descriptive Terms.—Every species, according to the system laid down by Carl von Linnaeus in the eighteenth century, properly has two names, a generic and a specific appellation. The average man speaks of the plane used for his household carpentry merely as a "plane," but the professional worker would more definitely refer to it as a "trying-plane," "jack-plane," or "smoothing-plane," as the case may be. The same ruling applies to the naming of our animals and plants, but, as the names are Latinised, the noun (or generic name) is placed first, and is followed by the adjective (or specific name). Thus on p. 149 of this volume the generic name *Portunus* appears; here are included two kinds of edible crabs, either of which may correctly be spoken of as *Portunus;* as, however, there are two kinds, or species, something more definite is needed, so we call one of them *Portunus pelagicus* (or open-sea Portunus), and the other *Portunus sanguinolentus* (or bloody Portunus). It naturally follows that any one specific name can be used only once in a genus, while a generic

name once applied to certain described forms cannot be used for any other animal. The question of synonymy has been discussed by Mr. Edgar R. Waite, in his Handbook of the Fishes of South Australia, 1923, p. 9.

Constant differences of structure separate one species from another, and in the same way broader characters distinguish genus from genus; a group of genera which have certain features in common are placed together under a family name, an allied set of families form a tribe, and so on.

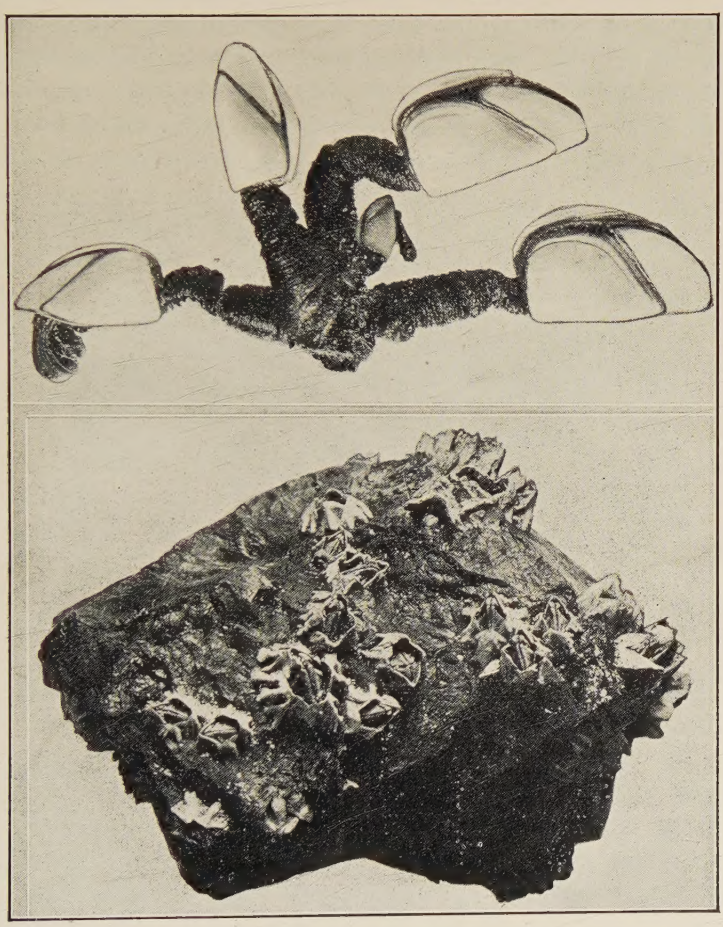


FIG. 3.—Stalked and sessile barnacles.

Even in these enlightened days people who should know better sometimes question the necessity for the use of latinised names in classification and of accurate scientific language in descriptions. Huxley pointed out that if a sailor were to name the different parts of his vessel to a layman, the latter would become lost in a maze of, to him, unintelligible technicalities. Nevertheless, in every trade and profession a specialized vocabulary is

necessary and, similarly, it is impossible to briefly and concisely describe the structural peculiarities of any animal without adopting the definite and standard nomenclature of its parts.

Methods of Collecting.—Crustaceans are found in the sea, in fresh and brackish water, in brine, on the land, and even in the "waters under the earth." As previously indicated, some are parasitic upon fishes, and others upon members of their own class. Of these last, some degenerate forms even go to the extreme of battening on to the parasitic barnacles which infest crabs, while a parasitized crab may be a species which itself lives as a commensal between the mantles of a bivalve mollusc. The method adopted for obtaining specimens naturally depends upon the habit and habitat of the species sought. Terrestrial Isopods may be captured by turning over stones or logs, and by sifting moss and leaf debris in damp situations;

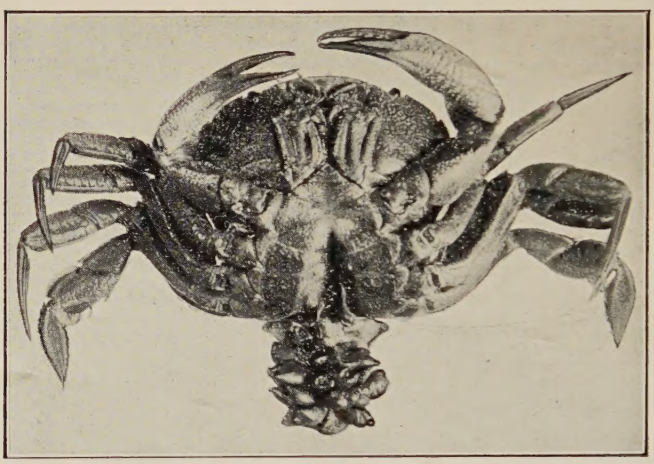


FIG. 4.—Rock-crab with degenerate parasitic barnacles attached to abdomen, or "tail."

species which dwell commensally in ants' nests are sometimes found under stones, or are turned up by digging out the nests. Fresh-water crustaceans may be taken by sweeping a hand-net through weeds, by baiting a hoop-net made on the lines of a small crab-net, by searching in burrows or under submerged stones, or with the aid of formalin, as described below. Some of our forms, such as *Crangon*, *Sphaerodema quoyana*, and certain crabs, excavate holes in estuarine mud-banks or mud-flats, and in sand. Others—as, for instance, *Callianassa*—burrow on the sea-shore below high-tide mark; crustaceans of such habit may be often secured by digging. During certain seasons the reefs of our Gulfs yield a rich harvest at the periods of low-tide. Here, stones may be turned over, and the varied mass of life on the undersides examined, a hand-net may be used, or a baited net may be lowered into rockholes. After rough weather a search along the beach is often productive.

Many small crustaceans of the same colour as their surroundings are to a great extent overlooked by any of these methods, and a far more certain way of ensuring success is to immerse and rinse weeds, stones, sponges, corals and other littoral varia for a short time in a weak solution of formalin (or formaldehyde) contained in a suitable vessel. About a tablespoonful of commercial formalin is sufficient for a bucketful of sea water; this solution is not strong enough to immediately kill small animals concealed in burrows, in tubes, or those that cling closely adpressed to vegetation, but it causes them to abandon their retreats. After a time they die and sink to the bottom of the receptacle, together with a more or less considerable amount of sand and debris. The poisoned water is then carefully poured off and the sediment is placed into wide-mouthed bottles of spirit. A later close examination of this uninviting mass usually reveals the presence of wholly unsuspected forms. This procedure was evolved by Dr. Keppel H. Barnard, of the South African Museum, and from practical experience I can say that it is most effective.

If pot-holes or rock-crevices left full of water by the receding tide are poisoned with chloride of lime or with formalin, crowds of small Crustacea appear in situations which before were apparently destitute of animal life. The procedure is illegal, and it is necessary to obtain permission to use poison in this way.

For obtaining species which live in deeper water a dredge is required. Stones, masses of weed, etc., brought up by the dredge yield many small species if passed through the formalin bowl. "Tangles," or lengths of teased-out rope, may be fastened to the dredge; spiny crustaceans which have escaped the net often become entangled in these trailing traps. A simpler net may be made on the pattern of a butterfly-net without the handle; a weight is fastened to the towing-rope a yard or so in advance of the net and, as this is dragged over the bottom, small crustaceans are stirred up and caught in the following net. The curious form *Parastacilla truculenta*, together with other material, was secured by this method.

Small Crustacea floating near the surface may be obtained by slowly towing a fine-meshed net at or near the surface, and any of the several forms of lobster-trap may be lowered in fairly shallow water for the capture of some of the larger species.

Methods of Preserving.—Wherever possible, crustaceans should by preference be preserved in fluid, and for this purpose three parts of alcohol to one of water forms a good medium. Pure alcohol is not available to the average citizen excepting at a prohibitive price, but an impure form (commercial methylated spirit) can always be cheaply secured; some samples of methylated spirit will not stand much dilution with water. Formalin should not be used as it hardens connective membranes, to some extent decalcifies the skeleton, and in general renders specimens so brittle and stiff that they are useless for detailed examination. If large examples are intended for

cabinet storage, the soft parts may be removed and the specimens preserved in a dry state; such a method requires care and is not to be greatly recommended, for crustaceans treated thus are, of course, quite inflexible and easily broken.

In 1900 Mr. O. A. Sayce formulated a method of treatment which is excellent for those Crustacea which have a hard exoskeleton. The formula for the preservative mixture required is as follows:—Glycerine, 1½ parts; water, 1 part; alcohol, 1 part; mercuric-bichloride, 1/2000 part. Either fresh specimens, or those previously preserved in alcohol, are immersed in this mixture for a period; they are then removed and, when the surplus moisture has drained from them, they may be placed in storage. The appendages remain quite flexible, and in some cases the colours are not so readily affected as in specimens wholly dried or those preserved in spirit. The time of immersion depends upon the size of the animals. Sayce says that "with the more bulky ones, such as the Fresh-water Crayfish, and larger forms, a small hole should be drilled in the carapace over the region of the heart, and by a small glass syringe some of the mixture should be injected through into the blood space, and a few punctures made with the blade of a knife in the intersegmental membranes. Ten days' immersion will suffice for *Astacopsis*. For specimens of such a size as our common shore crab, and larger forms, slit the membrane that unites the carapace to the reflexed abdomen, on the upper surface from one side to the other, and place in the mixture for at least a week." Sayce used methylated spirit in compounding his mixture, but, in practice, the present-day commercial spirit has proved unsatisfactory, as its dilutants, added to render it unfit for human consumption, form a brown precipitate in action with the mercuric-bichloride (or corrosive sublimate), which is a violent poison and prevents insect pests from attacking cabinet specimens. I have used this method for some time, and have examined crabs treated by Mr. Sayce over 20 years ago; they are still flexible, and the only evident drawback to the method of preservation is that they have assumed a dark brown colour: nevertheless, specimens immersed in alcohol, or dried in the usual way, become bleached during that period, so that an alteration of colour results in any case.

It is also advantageous to use this solution instead of alcohol for the preservation of small form such as Amphipods and Isopods—which must be kept permanently immersed in the fluid. It will be found that the dissection of specimens treated thus is greatly facilitated; the glycerine is easily removed from parts required for mounting on microscope slides. Labels require to be written in pencil as the mixture affects Indian ink.

Labelling.—The subject is apportioned a separate heading in order to emphasize a need for detail in this particular which is very often neglected by collectors, amateur and otherwise. It is most useful to record all data possible concerning the species collected. The depth at which a crustacean

is dredged, or its any other situation, together with a note on environment (such as the name of the weed with which it is associated) the locality, the name of the collector and the date, should be written in pencil on a slip of paper, which is dropped into the bottle or tube with the animal to which it refers. If the specimens are preserved in alcohol the labels may, if desired, be written with Indian ink. With parasitic forms the name of the fish or other host, and the part of the host from which the parasite is taken, should be noted.

Admittedly, it is often impossible to supply all of the details mentioned above, but the exact locality at least can always be recorded by the collector.

Measurements, Illustrations, etc.—In referring to recent scientific descriptions, it will be noticed that, in most cases, the measurements of an animal diagnosed are quoted in metric terms. Such measurement has proved far more convenient in usage than the more laboured English rulings. It is easy to understand that, if each of the many workers of other countries used his particular national system of measurement, much confusion would result, for science is cosmopolitan, and so a cosmopolitan rule of measurement must be adopted as a standard.

The advantages of the simple metric system are obvious, but as, unfortunately, this is not yet widely adopted in Australia, a key rule showing the scale in millimetres, and the equivalent in inches, is given below; also, the sizes of our crustaceans are herein quoted in inches as well as in millimetres. The maximum size of a species is indicated in most cases, and the average length of the specimens collected will naturally be smaller.

The name following the generic or specific names is that of the author who originally named and described the genus or species quoted; systematists will understand that authors' names are placed in brackets to avoid confusion on part of the layman. If a species is represented in the South Australian Museum collection, the symbol "S.A.M." is placed in brackets at the end of the description.

Some of the illustrations reproduced herein are not my own; in such cases the names of the authors who originally published the figures are given. A few of the drawings were prepared by me to illustrate papers in the "Transactions of the Royal Society of South Australia," the "South Australian Naturalist," the "Records of the South Australian Museum," the "Proceedings of the Linnean Society of New South Wales," the "Australian Museum Magazine," etc. I am indebted to these sources for permission to republish these figures, and in some cases for the loan of blocks.

Chapter II.—THE SUBCLASS MALACOSTRACA.

The primary sub-divisions of the Malacostraca are shown in the table on the following page. The members of the sub-class fall into two main divisions or "series"—the Eumalacostraca and the Leptostraca. In the last-named the abdomen, or tail, consists of eight segments, whereas in the Eumalacostraca it never has more than seven. The Leptostraca includes only a few small species, and the further characters of this little series are conveniently dealt with at the end of the handbook. The series Eumalacostraca, on the other hand, is very large; all its representatives have certain characters in common, but amongst the families there are vast and apparent differences of form and function. The series is separated into four "divisions," each of which is further divided into "orders." Of these last the Decapoda includes the largest and most economically important of the Crustacea, and under this heading are found all our better-known species. As each order is dealt with in turn, its further sub-division is discussed, but the order to which any Eumalacostracan belongs may be determined with the aid of the key at the end of this chapter.

Series EUMALACOSTRACA.

External Anatomy.—An Eumalacostracan appears, at first glance, a complicated animal, but in reality is moderately simple in structure. It is

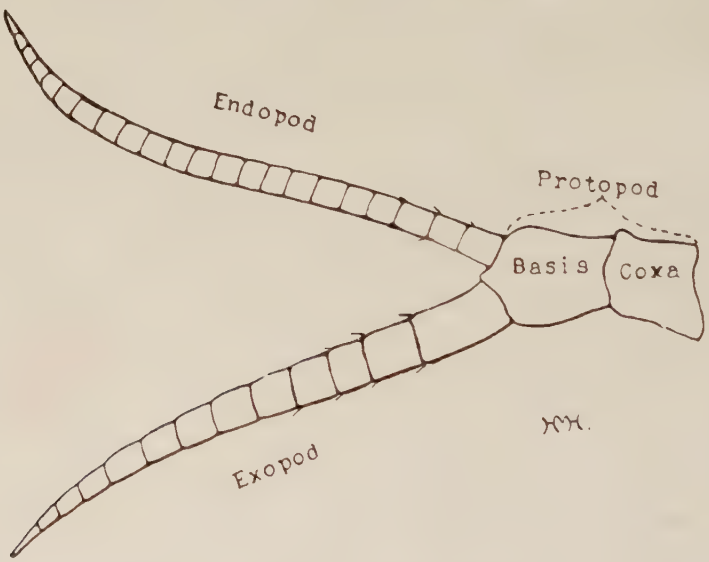
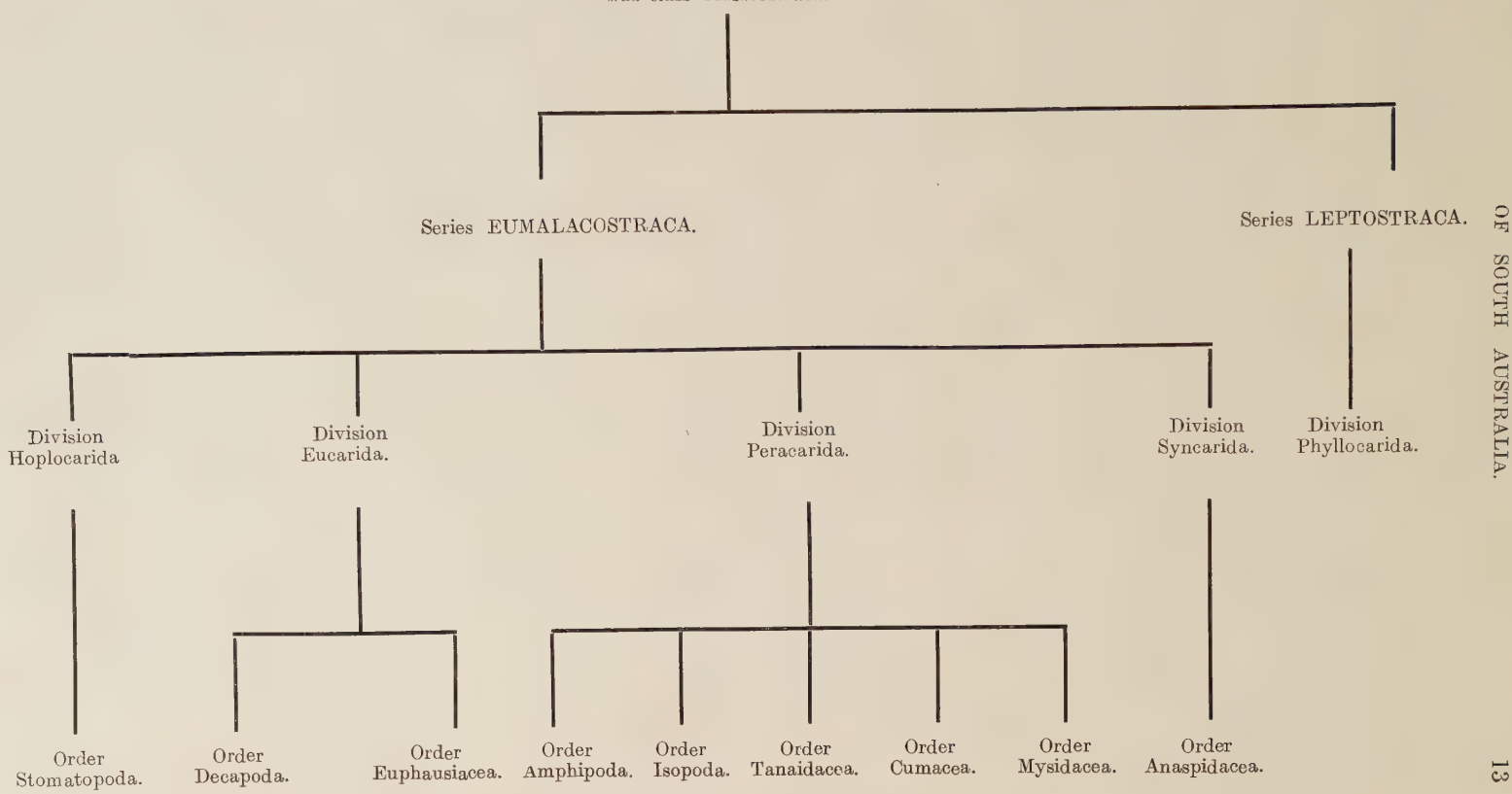


Fig. 5.—A simple crustacean appendage.

necessary, when studying any group of animals, to understand the general plan upon which its members are built. The animal, as a whole, is divided into three parts: head, thorax, and abdomen. The head is composed of at least five, but constantly more or less coalesced segments, and bears five

PRIMARY DIVISIONS OF MALACOSTRACA.



pairs of appendages, and usually a pair of eyes. The thorax consists of eight segments, which are not always evident, each of which bears a pair of appendages. As mentioned above, there are seven segments in the abdomen, but the apparent number may be less owing to fusion, and to all excepting the last, is attached a pair of appendages.

A simple or "primitive" appendage (fig. 5) consists of a base or "protopod" of two segments, styled the "coxa" and "basis." From the basis arises an outer branch, or "exopod," and an inner branch, or "endopod." In appendages of different function some of these parts may be absent, and the remainder greatly modified. The whole series of nineteen pairs is generally all developed in some form or other, but one or more pairs may be entirely suppressed. The number of appendages varies greatly in the other sub-classes, and may be far in excess, or much less, than in the Malacostraca. There are indications that the primitive appendage was more complicated than the simple biramous type cited above, but for the present the definition will suffice.

The appendages of the thorax are always well differentiated from those of the abdomen. Usually at least some of the thoracic limbs are ambulatory, the endopod forming the walking leg, while the outer branch is absent, or developed as a swimming organ. The abdominal appendages are, as a rule, biramous, with the two branches similar in shape and function. Where such condition does not occur mention is made of the modification. The eyes have been treated by some workers as modified appendages, but the evidence afforded by the study of the embryology of certain forms does not support the assumption.

At this stage it will be helpful to examine two very different South Australian Eumalacostraca, and to discuss their modifications of the general plan. Before using the keys and descriptions it will also be necessary to learn the terminology of the structural details.

The first example chosen to demonstrate the structure is the Murray Lobster, or Murray Crayfish, a familiar crustacean of large size (fig. 6). The tail, or abdomen, consists of seven articulated somites (the second to sixth of which bear each a pair of biramous appendages), but the head and thorax are protected by a hard undivided casing, the "carapace," which is produced between the eyes to form a beak or "rostrum." At about the middle of the length of the carapace there is a deep transverse groove ("cervical groove," or "branchial groove"), which is regarded by some as marking the hinder limit of the head region. Behind this groove the shield is continued over the thorax; it is fused with the thoracic somites down the middle of the back, but hangs free at the sides. The gills are enclosed in the space between the side walls of the thorax and these lateral flaps, which are known as "branchiostegites" or gill-covers. As both cephalon and thorax are covered by the carapace, this part of the body is conveniently termed the "cephalothorax." The cephalothorax carries a pair of eyes and thirteen

paired appendages, the last eight of which must be assigned to the thorax; the abdomen bears only five pairs of appendages, for our fresh-water crayfishes have no swimmerets on the first pleon segment.

As previously noted, the stalked eyes are not regarded as true appendages. Following the eyes is the first pair of antennae, or "antennules," which consist of a three-jointed base and two lashes or "flagella"; as shown in fig. 7, B. to H., all the true appendages are on the common plan which has been outlined, but in this pair it is said that the lashes do not represent the endo- and exopod. The second antennae have a two-jointed protopod, the exopod represented by a movable scale or "acicle," and the distal part of the endopod drawn out into a long, many-jointed flagellum. On the first segment of this pair of feelers is an elevation, bearing the aperture of the renal excretory gland, which is known as the "antennal gland," or, in the

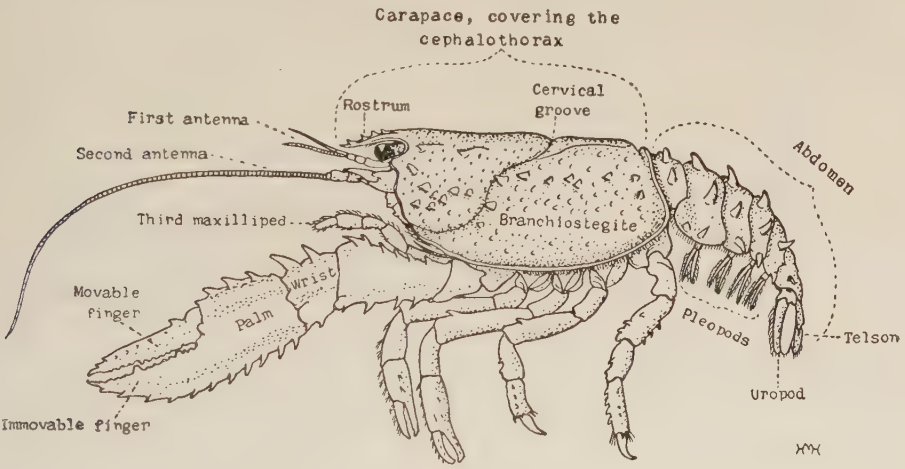


FIG. 6.—Murray Crayfish (*Astacopsis serratus*) (⅓ nat. size).

Decapoda, as the "green gland" (fig. 7, B. r.). The third appendages are the massive mandibles, which are followed by two leaflike organs, the first and second "maxillae." This completes the series of the head region. The first three pairs of thoracic appendages are modified as "maxillipeds," or mouth feet. The protopod of the first maxillipeds (as in the two pairs of maxillae) is expanded into two large, bristle-fringed plates ("gnathobases") which serve as jaws. The second and third maxillipeds resemble one another, but the third are much the larger. These two pairs of appendages, like the first to fourth pair of legs, bear an "epipod," to which a gill is attached. It will be noted that in the mandibles and maxillae the protopod is much modified, and forms the main body of these appendages, while the exo- and endopod, when present, are represented in most cases by "palps" only. In the succeeding appendages the endopod becomes the major portion of the limb, and, from the second maxillipeds backwards, consists of five distinct joints. Thus, with the protopod, the main part of these limbs is composed

of seven segments, which are named respectively the "coxa," "basis," "ischium," "merus," "carpus," "propodus," and "dactylus" (fig. 7, H. 1 to 7). In the second and third maxillipeds and the first pair of legs the basis and ischium are fused together, but are marked off one from the other by a furrow. The first pair of legs bear large crushing hands or "chelae," and are termed "chelipeds"; the posterior part of the propodus is swollen and enlarged, forming a "palm," and alongside the dactylus, or "movable finger," a process ("immovable finger" or "thumb") has grown out from

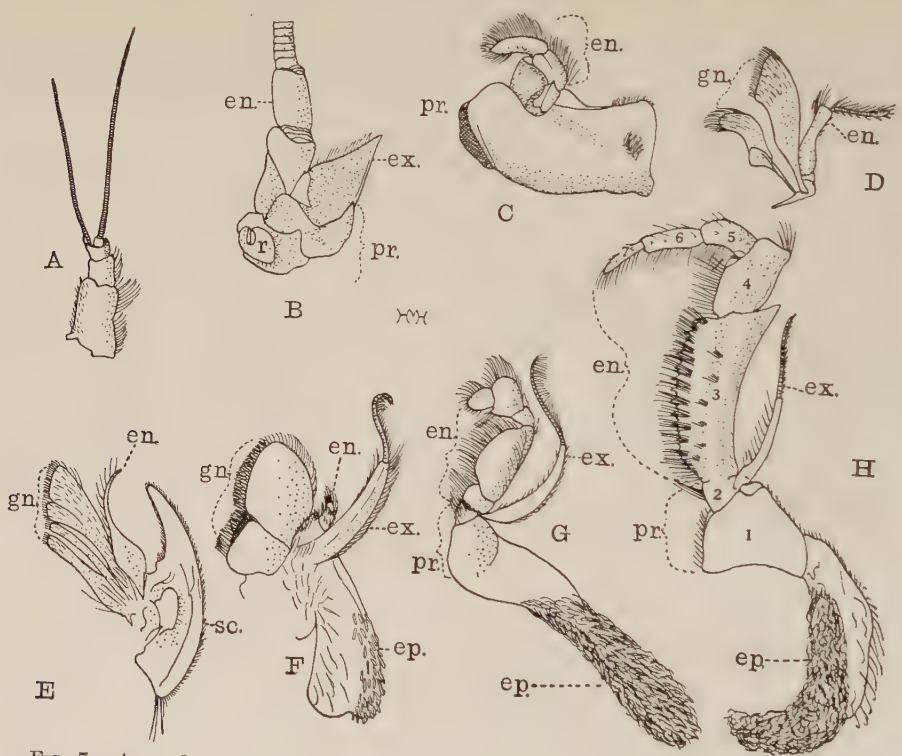


Fig. 7.—Appendages of Murray Crayfish. A, First antenna; B, second antenna; C, mandible; D, first maxilla; E, second maxilla; F, first maxilliped; G, second maxilliped; H, third maxilliped; pr., Protopod; en., endopod; ex., exopod; ep., epipod; r., opening of renal organ; gn., gnathobases (borne by segments of protopod); sc., scaphognathite (a modification of the epipod, or probably both epi- and exopod). 1, Coxa; 2, basis; 3, ischium; 4, merus; 5, carpus; 6, propodus; 7, dactylus (all nat. size).

the propodus. The carpus of chelate limbs is often referred to as the "wrist." The last four pairs of thoracic appendages are the walking legs, the first two of which terminate in small chelae. The abdominal appendages each consist of a protopod with two branches, the endo- and exopod. Those of the sixth segment are termed "uropods," and differ from the others (the swimmerets, or "pleopods") in having a single-jointed protopod and large-flattened branches; the uropods, together with the last abdominal segment, or "telson," form a powerful swimming-fan (fig. 8).

If the sides of the carapace are cut away the brush-like gills or "branchiae" are exposed (fig. 9). There are twenty-one of these gills on each side; six, as mentioned above, are attached to the epipods of the second and third maxillipeds (fig. 7 G and H, ep.; and fig. 9, p.[1] and p.[2]), and of the first to fourth legs (fig. 9, p.[3] to p.[6]), and are known as "podobranchiae"; the epipod of the first maxilliped bears a rudimentary gill (fig. 7 F, ep.). The articulating membranes between the basal joints of some of the limbs and the body bear gills, which are termed "arthrobranchiae." There is one arthrobranch on the articulating membrane of the second maxilliped and two on that of the third maxilliped and of the first to fourth legs. Lastly, the side walls of the thorax bear a gill on each of the last four somites; these are styled "pleurobranchs." The gills vary in number and disposition in different crustaceans.

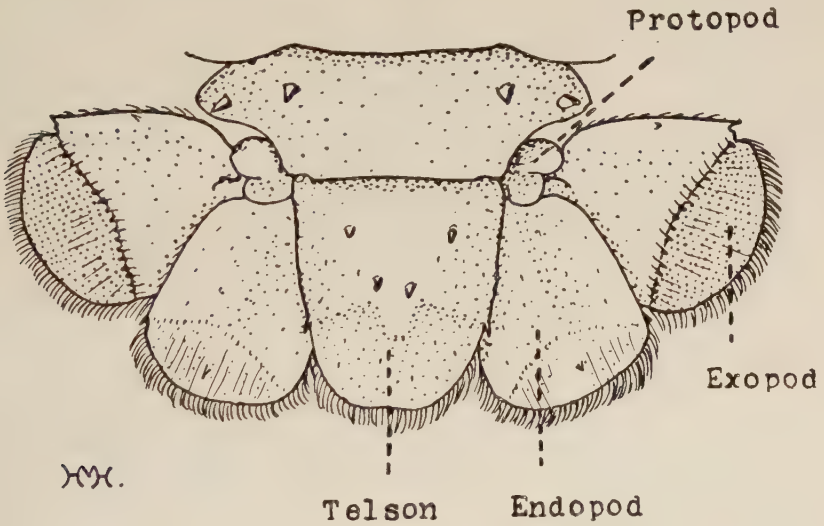


Fig. 8.—Tail-fan of Murray Crayfish (nat. size).

With the gill-cover removed it will be noted that a channel just below the lower part of the cephalic groove of the carapace runs forward from the branchial chamber towards the mouth. In this canal lies a large plate, or "scaphognathite," which is part of the second maxilla (sc. in fig. 7 E, and in fig. 9). During life the scaphognathite is continually vibrating, causing a current to flow out of the gill-chamber through this channel, so that the gills are constantly bathed in renewed water, which is drawn into the branchial cavity between the bases of the legs and the lower edge of the carapace.

Now let us compare with the Murray Lobster a crustacean which lives amongst the "sea grass" on the bottom of St. Vincent Gulf. This is an elongate green Isopod, one of the "sea-centipedes" (*Crabyzos longicaudatus*), which attains about 2 inches in length. The popular name

is due to a supposed resemblance to the true centipedes. Apart from the disparity in size and general shape, the three parts of the animal and the appendages of those parts are very differently modified. Here there is no extensive and elongate carapace enveloping the cephalothorax, but in front is a distinct head, with a pair of rather small, sessile eyes. The thorax is composed apparently of seven segments, the first of which is partly fused with the head, and each of which bears a pair of legs of similar pattern. According to the general plan, however, there should be eight thoracic somites. An examination of the appendages emanating from the front and underside of the "head" shows that six pairs are here present. As we know, five pairs belong to the head proper, and the sixth are thoracic. From this it is evident that the first true thoracic somite is so completely fused with the head that there is no line of demarcation. Thus the first free (or, in this

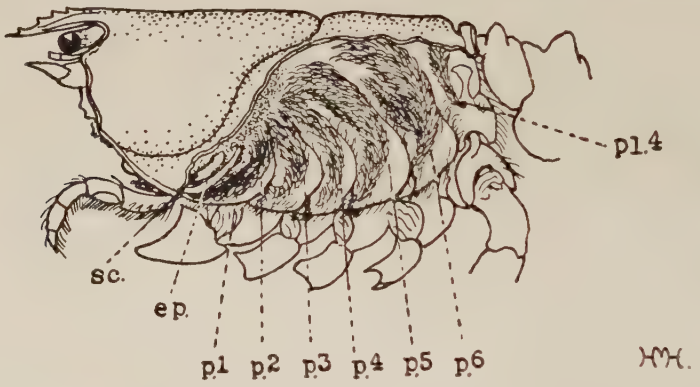


FIG. 9.—Thorax of Murray Lobster, with branchiostegite cut away to expose gills, etc. sc., Scaphognathite of second maxilla; ep., epipod of first maxilliped; p.[1] and p.[2], podobranchs of second and third maxillipeds; p.[3] to p.[6], podobranchs of first to fourth legs; pl.[4], the last of the four pleurobranchs (the podobranchs overly and conceal the first to third pleurobranchs and the arthrobranchs) (½ nat. size).

case, but partly free) segment is in reality the second segment (fig. 10 A). The five pairs of truly cephalic appendages are respectively developed as first antennae, second antennae, mandibles, first maxillae, and second maxillae, but are of very different appearance from those of the Murray Lobster. Only the first thoracic pair is developed as maxillipeds, those of the first and second *free* thoracic segments not being used for feeding, but, in common with the remaining legs, are sub-prehensile and ambulatory. Again, an examination of any one leg discloses only six free joints (fig. 10 B). The first, or coxal joint, is fused with the edge of the body somite, and below forms a socket in which the basis of the limb is articulated.

The structure of the abdomen is no less astonishing. Viewed from above, it consists of a single, tapering segment; below, it is covered by two elongate flaps, hinged to the lateral edges and meeting on the median line. The dorsal segments have all become soldered together, and two faint grooves on each

side, near the base, are the only remaining traces of the sutures. The flaps on the underside are much-altered uropods, the protopod and endopod together form little doors, which, when opened, reveal five pairs of thin, flat pleopods packed against the concave underside of the abdomen (fig. 10 C). In this case the uropods do not assist in locomotion at all, but serve to protect the remainder of the abdominal appendages, which are respiratory and natatory in function. The mouth appendages of the Isopoda are described later in the book.

Although our Murray Lobster may be taken as fairly typical of the higher Malacostraca, it can now be seen that there is a marked diversity of form,

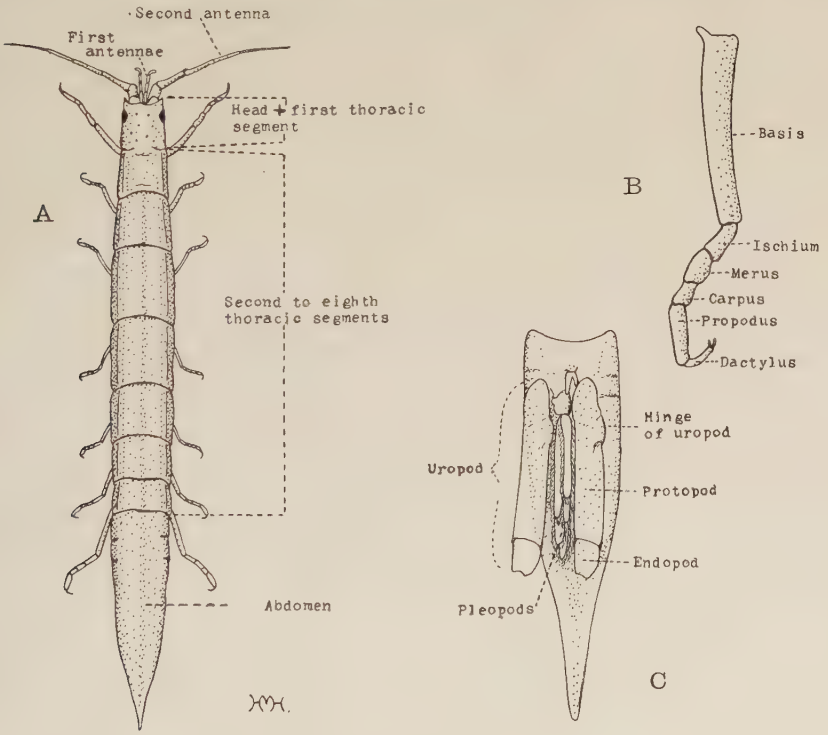


FIG. 10.—Green Sea-centipede (*Crabyzos longicaudatus*); A, dorsal view (x 2); B, last leg (x 6); C, ventral view of abdomen, with right uropod opened to show pleopods (x. 3½).

and considerable variation of the appendages in form and function, amongst the members of the sub-class. It is by means of such differences that the crustaceans are classified. Fundamentally, all are built upon similar lines, but, owing to these modifications, the external anatomy of each order must be described in place.

The parts above cited as head, thorax, and abdomen do not necessarily correspond to the parts so designated in other animals. Various alternative names, which are in some cases an improvement, are in usage. Thus the head may be spoken of as the "cephalon" or "cephalosome" (head-body), while

the thorax is sometimes called the "mesosome" (middle body) or "peracon" (walking part); the abdomen may be referred to as the "pleon" (swimming part) or "metasome" (last body).

In reading the definitions of some of the larger groups it will be noted that certain characters are spoken of as being "usually" or "almost always" apparent. Such expression is often unavoidable, for, no matter how carefully a diagnosis of, for instance, a tribe is drawn up, some aberrant form may be found which will not agree with all the tribal characters of its undoubted relatives. Thus it is necessary to remark that in the order Decapoda gills are *usually* present. Gills are absent in only a few known cases—a dozen or so insignificant little pelagic prawns, which may be rarely or never met with by the reader, but which render necessary the insertion of the qualifying adverb.

Reproduction and Biology.—The sexes are always separate, and often distinctly different. In the Murray Lobster the pair of long, coiled tubes, or ducts (*vasa deferentia*), leading from the testes of the male, terminate on the basal joints of the last pair of walking legs. The two tubes leading from the ovaries of the female—the oviducts—end on the bases of the antepenultimate pair of thoracic limbs. The genital apertures are large, elevated, and very easy to find in both sexes.

In the great majority of the Eumalacostraca the genital openings of the male are situated on the last thoracic somite, and those of the female on the antepenultimate segment, as in the Murray Lobster. The apertures are in some cases on the sternal surface of the body, and in others on the articulating membrane or coxal joints of the legs. Recently it has been noted that the Isopoda-Valvifera (the Sea-centipedes) offer an exception to this rule, in that the genital openings of the male are situate on the first abdominal somite.

When attempt is made to determine to which division or species our various crustaceans should be referred to, it may be found helpful, and will sometimes be necessary, to know the sexes of the individuals under consideration. For instance, the position of the male or female openings often assists in deciding the relationship of a species, so, for this and other reasons, obvious external sexual characters and sexual differences are noted for many of the groups. Hermaphroditism occurs in the earlier stages of some degenerate Isopodan fish parasites, and a remarkable sexual dimorphism is exhibited in another Isopodan family (Gnathiidae).

Crustacea are oviparous. It is known that in most of the Malacostraca the eggs are carried about continuously by the female at least until they hatch; notable exceptions to this rule occur in the Anaspidacea (Mountain-shrimps), Peneidae (Pelagic prawns), and Stomatopoda (Mantis-shrimps). Parental care is displayed by certain species in that the newly-hatched young are retained for a time in a marsupium, or attach themselves to the underside of the abdomen or thorax, being thus protected by the mother until able to fend for themselves.

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

Many species undergo some very remarkable changes in their larval stages. If the collector tows a net at the surface of our seas he will, without doubt, secure various curious crustacean larvae, which may not remotely resemble the parent form. All species do not hatch from the egg at the same stage of development. Some emerge at a very early stage (Nauplius larvae), and at first exhibit no indication of the final form assumed. In others the young are hatched at various more advanced stages, and may pass through the larval metamorphoses in the egg and emerge as almost perfect tiny replicas of their parents.

It is to be regretted that the first stages of the majority of the higher Australian Crustacea are as yet unknown.

The habits and habitats of the Malacostraca are so varied that a broad introductory outline will not cover the subjects. Notes concerning these details are incorporated in place.

In many crustaceans it is difficult, and in others impossible, to retain the life-colours after death, no matter what method of preservation is adopted. This particularly applies to some of the smaller forms. Colour descriptions are appended herein wherever it is thought that they will be of use.

Moulting and Regeneration.—The exoskeleton of the Isopod described above is moderately flexible, and is not very strong. It is composed largely of chitin, a horny substance with which insects and other Arthropods are also encased. The shell of the Murray Lobster is also chitinous, but is much

Fig. 11.—Yabbie (*Parachaeraps bicarinatus*) in process of moulting; the partly shed exoskeleton is darker than the animal.

stronger, for it is very considerably thickened and hardened by the deposition of lime salts, which, in fact, form one of its main constituents. The exoskeleton of a crustacean (after it has hardened) is never perceptibly elastic, nor does it increase in size; to allow for growth, the animal has therefore to cast off its old covering periodically, and form a new and larger shell. In most of the larger Crustacea the moult is complete, the limy covering being discarded in one operation, but in some of the smaller

forms the integument is shed piecemeal. Before a moult is undergone the flesh becomes very flabby, so that the muscles of the legs and other parts may be withdrawn from their old sheaths. Fig. 11 shows a Yabbie, or Fresh-water Crayfish (*Parachaeraps bicarinatus*) in the act of moulting. The abdomen has been drawn out from the old exoskeleton, and the legs and thorax are partly free. The emerging yabbie is much paler in colour than the almost discarded "shell." After ecdysis the animal is at first soft, and the new covering, which was previously formed beneath the now discarded shell, is weak and thin. At this stage water is absorbed, and the crustacean quickly increases in size; then the covering is gradually hardened by the deposition of calcium-carbonate and other salts of lime. Moulting is frequent in the young, but it is probable that as the maximum size of a

Fig. 12.—Spider-crab (*Leptomithrax australiensis*) with oysters attached to carapace.

species is approached the act is seldom performed. It is on record that an European Shore-crab, commencing at the second larval stage, moulted 17 times in three years, and that a tiny lobster less than an inch in length grew to over 4in. during a similar period, and underwent 14 ecdyses; another lobster 4½in. in length moulted only seven times in five years and, at the end of that time, had attained a length of 9in. Old examples of crabs having a sluggish habit sometimes have oysters of at least two years' growth attached to the carapace, as shown in fig. 12, which represents one of our large Spider-crabs (*Leptomithrax australiensis*) with several Port Lincoln Oysters on its back.

The colourless blood of a Malacostracan is poured from the arteries into the spaces between the organs of the body; there are no true veins, the blood being conveyed through poorly-defined channels to the gills, and

thence again to the heart. It is well known that if some crustaceans are grasped by one of the larger legs, or if such a limb is injured, the animals are able to cast off the affected appendage at the smallest segmental connection; if a large limb is badly injured it is automatically disconnected at the weakest point by a reflex contraction of the muscles—otherwise the crustacean may bleed to death. The smaller area thus ruptured quickly heals over and, normally, the lost part is gradually reproduced, increasing in size at each moult, and eventually attaining its normal character and proportions.

Malformations.—Deformities are said to be usually due to injury received soon after a moult, when the exoskeleton is in a soft state. Dr. Calman remarks that, under circumstances not altogether understood, the process of regeneration may go wrong, and in this way various malformations and abnormalities result. A deformity may be perpetuated, notwith-

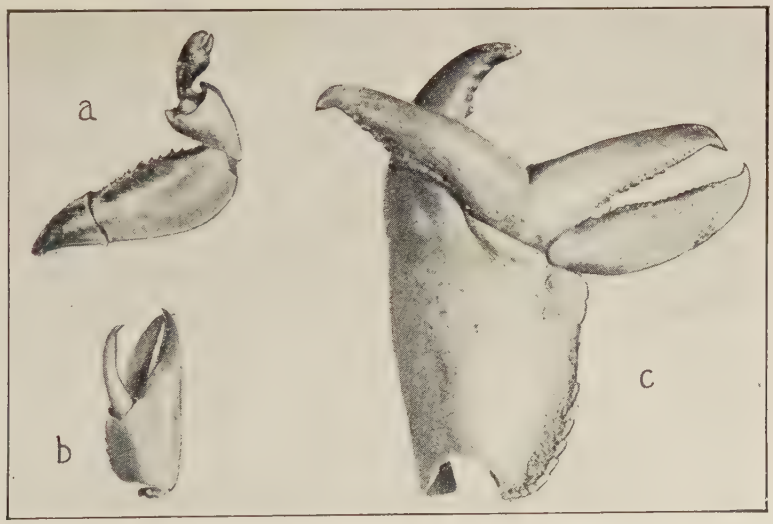


Fig. 13.—Abnormal chelae of Yabbies.

standing further ecdyses, and so become a permanent character of the individual concerned. The most commonly noted malformations are those of the chelipeds of crabs, lobsters, and crayfish, but occasionally in forms such as shrimps the antennal scale of one side is atrophied, though perfect in form.

Fig. 13 shows different results of injury to one of the large chelipeds of three Yabbies (*Parachaeraps bicarinatus*). In the example shown at (a) the whole of the pincer (propodus and dactylus) have been previously lost, and a tiny, ineffective, but nevertheless operative chela has grown from the distal membrane of the carpus; a lateral extension of the basal end of the little propodus moves on the lower apical edge of the carpus. The propodus

of the chela marked (b) appears to have been injured at the base of the mobile finger; from this point has grown a narrowly falcate, movable, but quite useless finger, which is not of characteristic form. A sharp curved spine, not present in typical examples, springs from near the base of the thumb and, owing to slight distortion of the lower part of the propodus, the tips of the normal finger and thumb are crossed. At (c) the chela of a very large specimen is shown; in this the movable finger is tridactylate; the three fingers are solidly fused proximally, and the common base is so connected with the much enlarged and distorted articular opening as to allow slight movement. This chela is useless, as the inner member of the deformed portion obliquely crosses the thumb; the two outer fingers are in apposition, but are, of course, inoperative.

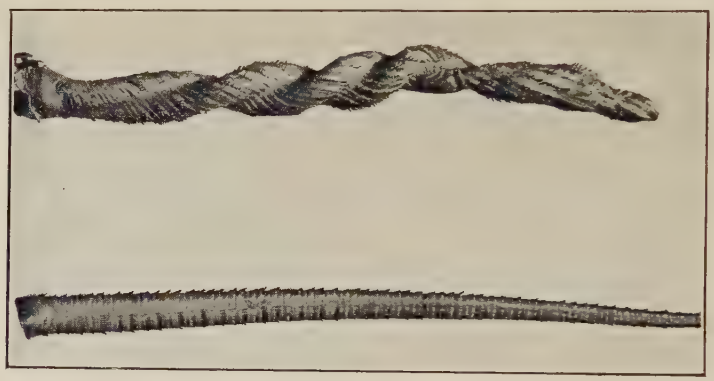


Fig. 14.—Deformed second antennal flagellum of Spiny Lobster (*Jasus lalandii*), with perfect lash for comparison.

In fig. 14 the deformed flagellum of the second antenna of a Rock Lobster or Crayfish (*Jasus lalandii*) is depicted, and below it is shown a perfect feeler for comparison. The malformed flagellum is less than one-half its normal length, and is curiously twisted in a spiral form.

Keys.—Keys are formulated by a condensation or focussing of salient comparative characters, and tend to become particularly simple and useful when treating only of a limited faunal field such as our own, for if intermediate features occur in allied exotic forms they may be disregarded. As a handbook is of popular purport, obvious external differences are herein utilised wherever possible in preference to more obscure characters, which would become highly important if a wider range were considered. Thus the keys may not in every case be applicable to ex-Australian material, nor do they necessarily distinguish our species from exotic allies. In dealing with the order Decapoda, the system tabulated by Borradaile has been largely followed.

It is sometimes imagined that the practical utilization of a zoological key is an involved and even difficult proceeding. As a matter of fact, once

the principle is grasped, and after rudimentary knowledge of the external anatomy of a Malacostracan is attained, the interpretation of the keys should be a comparatively easy matter; with their aid a species is determined by a process of elimination. Supposing, for example, we obtain a specimen of the common Rock-lobster—the "Crayfish" of Adelaide markets —and wish to determine its relationship and the name of the species. The primary key on the next page is first referred to. On reading the characters given on the first line under (a) we find that these cannot be applied to the animal under consideration; therefore it must belong to section (aa), which includes the remaining orders. Referring now to the next heading (b), it is apparent that the Crayfish has a carapace covering the whole thorax and that it belongs to the division Eucarida, so that all divisions under (bb) may be disregarded so far as this creature is concerned. The differences between the two orders of the Eucarida are indicated under (c) and (cc), and as the Crayfish has three pairs of maxillipeds it belongs to the first—the Decapoda. Determination is now much further advanced, and on turning to the introduction to the Decapoda (Chap. IV.) the remarks there given lead to Chap. v., where the key to the tribes of the Creeping Decapods shows that the Crayfish is a member of the tribe Palinura, and so on.

The actual "running down" of a species in this way will, after a little practice, occupy less time than is involved in writing the above explanation; indeed, after a time, the initial keys need seldom be referred to. Until the salient characters of some of the main divisions become familiar, it might seem that there is an unnecessary amount of splitting and sub-splitting of the groups, into smaller and smaller sections, of the classificatory system. A little thought, however, will convince the reader that without extensive subdivision of orders containing a large number of species the task of determining the status of any one crustacean would be rendered very much more difficult.

COMMENTS ON KEY TO DIVISIONS AND ORDERS.

(1) For the sake of simplicity, the character of the thorax alone is here used to separate the Amphipoda and Isopoda under (f) from the Tanaidacea, under (ff). In the great majority of Isopods seven free thoracic segments are apparent but in rare cases, for instance, in the few species of the family Serolidae and in the Sea-centipede *Crabyzos*, the first and second segments are fused with the head, leaving only six articulated and movable somites. In the Serolidae, however, the uropods are lateral, forming a swimming fan with the telson, and in the Sea-centipedes the uropods are lateral and form large covers for the pleopods, whereas in the Tanaidacea the uropods are terminal with filiform branches.

(2) In the Isopodan tribe Phreatoicidea the outer ramus of the pleopods is cilated and the smaller inner ramus branchial; one species of this tribe (the species of which resemble Amphipods in general form) occurs in fresh water in Central Australia.

(3) In an ex-Australian genus three thoracic somites are involved in the carapace.

None of the few little species included in the orders Euphausiacea and Anaspidacea is recorded from South Australia. The division Syncarida was founded to receive certain fossil Crustacea from Europe and America; a few small species related to these fossil forms, and found in fresh-water in Tasmania and Victoria, comprise the order Anaspidacea.

KEY TO DIVISIONS AND ORDERS OF EUMALACOSTRACA.

a. Eyes and first antennae attached to separate movable somites of the head .. ..Division Hoplocarida, Order *Stomatopoda.*

aa. Head somites never separate.

b. Carapace large, covering all the thoracic somites. Division Eucarida.

c. First three pairs of thoracic appendages modified as maxillipeds .. .. Order *Decapoda.*

cc. None of the thoracic appendages distinctly modified as maxillipeds .. .. Order *Euphausiacea.*

bb. Carapace of moderate or small size, never covering all thoracic somites.

d. Female with a brood pouch or marsupium beneath thorax.. .. .. Division Peracarida.

e. Carapace very small; very rarely involving more than the first two thoracic somites.

f. Carapace vestigial; usually only the first thoracic somite fused with head, the remaining seven more or less free. ([1]).

g. Abdominal appendages not developed as respiratory lamellae. Body usually compressed.. .. .. Order *Amphipoda.*

gg. All but last pair of abdominal appendages developed as flat, thin, respiratory plates. Body usually depressed ([2]). Order *Isopoda.*

ff. Carapace small; almost always only the first two thoracic somites fused with head, leaving six free somites ([3]). .. .. .. Order *Tanaidacea.*

ee. Carapace moderately well developed, involving at least three thoracic somites.

h. Eyes sessile. Uropoda slender, forked rods, not forming a tail-fan with telson.. .. .. Order *Cumacea.*

hh. Eyes stalked. Uropoda flattened, forming a tail-fan with telson.. .. .. Order *Mysidacea.*

dd. Female without brood pouch .. .. Division Syncarida, Order *Anaspidacea.*

Chapter III.—Order STOMATOPODA. The Mantis Shrimps.

Besides the unique division of the head into three movable somites, which is referred to in the key, there are other noteworthy features which distinguish the remarkable "Mantis-shrimps." The carapace is small, leaving exposed at least the last four thoracic somites; a small rostral plate, hinged to the anterior margin of the carapace, overlies the segment bearing the first pair of antennae, each of which has three flagella. The first five pairs of thoracic appendages are all similar structurally, being six-jointed, with the last joint (dactylus) folding back on the penultimate joint (propodus), and so forming a subchelate hand (fig. 15). Those of the second pair are greatly developed, and are much larger than any of the others; the finger is furnished with several long teeth, and folds against the edge of the propodus, where deep pits sheath the spines of the finger.

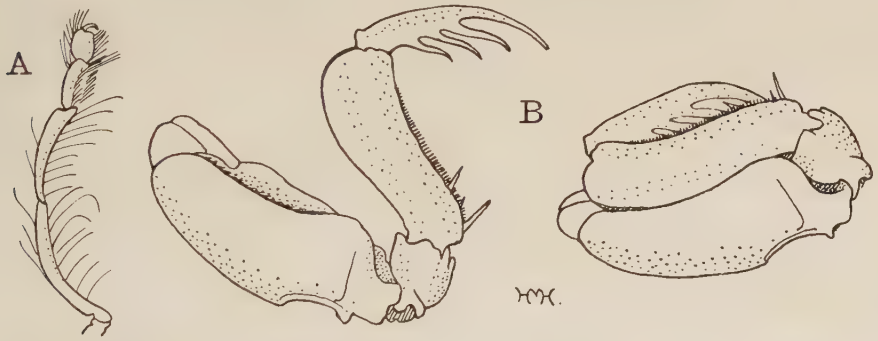


Fig. 15.—*Squilla miles*; A, first thoracic limb; B, second thoracic limb, open and folded (x 1½).

The propodus has some movable spines near the base, and altogether this pair of limbs constitutes an efficient apparatus for the capture and retention of living prey. It is owing to a fancied resemblance of these raptorial limbs to those of the familiar terrestrial Praying Mantids that the Stomatopods have received their popular designation; the name of the order literally means "mouth-feet." The sixth to eighth pairs of thoracic appendages are slender and biramous. The base is three-segmentate: the outer ramus is thin, linear, or lamelliform in shape (fig. 17 B, o), while the inner branch is stout and two-jointed; it is said that, contrary to the usual condition in the class, the outer ramus is the endopod and the inner the exopod. The abdomen is very large with well-developed appendages, the last pair (uropods) forming a tail-fan with the telson.

Respiration.—The members of this division are further remarkable in that the gill-apparatus is attached to the pleopoda. The base of each pleopod is broad and the two branches form membranaceous plates, each of which is obscurely divided into two parts (fig. 16). On the inner margin of the

inner branch is a short appendage, bearing a great number of tiny coupling-hooks which serve to link each pair of pleopods with its neighbour; a gill, consisting of a stem carrying the branchial filaments, arises from the front side of the outer branch, quite close to its junction with the base.

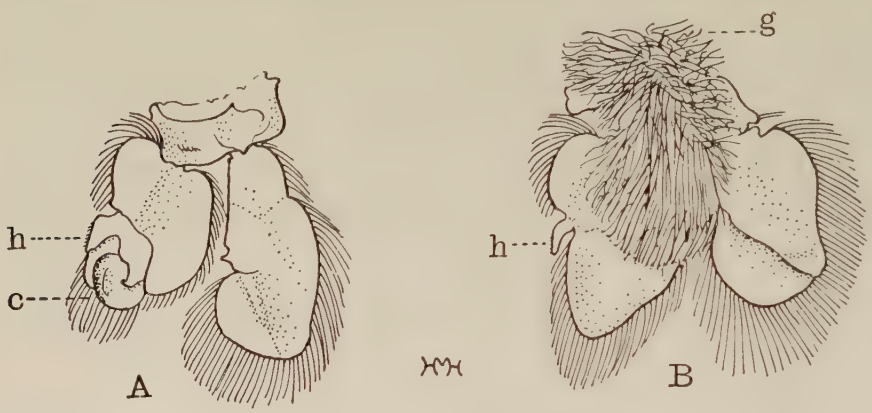


Fig. 16.—*Squilla miles;* A, first pleopod of male (gill removed); B, second pleopod. h, Coupling hooks; g, gill tufts; c, clasper (x 2).

Reproduction and Development.—In the male the vasa deferentia pass through the integument of the basal joint of the last thoracic limbs, and are continued along a pair of long, chitinised, two-jointed penes (fig. 17 B, p) the exterior opening of each vas deferens is situate at the extremity of these organs: the inner plate of the first pair of pleopoda is, in this sex, remarkably modified as a clasping organ (fig. 16 A, c). The ovaries of the female, like the testes of the male, are for the greater part contained in the

Fig. 17.—*Squilla miles:* A, sternum of sixth thoracic somite of female, showing openings of oviducts and receptaculum seminis (x 4); B, last thoracic somite and limbs of male (x 2). o, Outer ramus of limb; p, penes.

abdomen; the apertures of the oviducts are found one on each side of the middle of the ante-penultimate sternal segment of the thorax (the somite bearing the first of the three last slender pairs of appendages); between these openings is a pocket which serves as a receptaculum for the male sperm (fig. 17 A).

Most of the Mantis-shrimps live in burrows, although they may wander far in search of food, which is captured with the large raptorial appendages.

It seems that the eggs are not generally carried about by the female, as with most other Malacostraca; they are small, and are cemented together in a mass which is deposited in the burrow, or carried about by the third, fourth, and fifth pairs of sub-chelate thoracic limbs: in a burrow water is circulated over the eggs by a fanning motion of the pleopods of the female. The young undergo an extraordinary metamorphosis before attaining the adult form, and the immature stages of the various species differ to a greater extent than do the adults of the same forms. The early stages extend over a very long period, during which the animals are pelagic: these

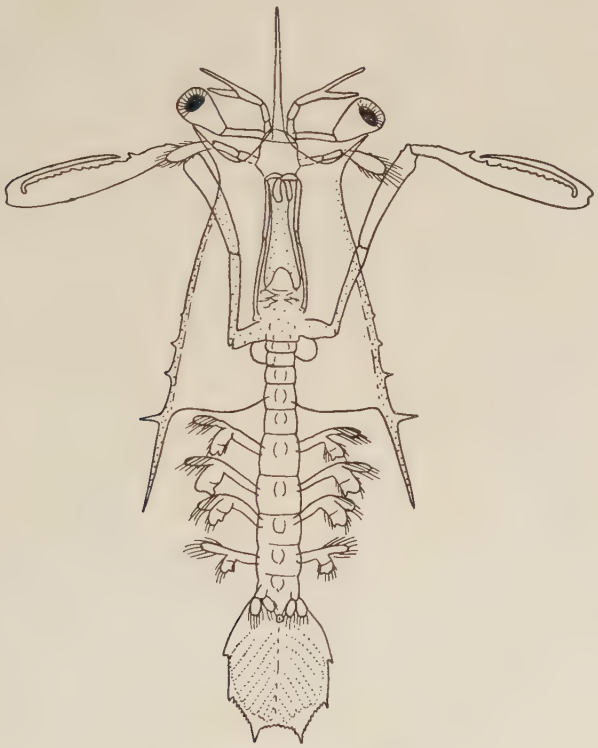


Fig. 18.—*Alima* larva of *Squilla* (after Brooks, x 10).

larvae are plentiful in warm seas: they are often of large size, and have been described under various generic names (which are now used to denote the different types of larvae) and were at one time included in a separate family of the Stomatopoda, the Erichthyidae. In the light of recent research it appears that several so-called "species" of larvae may represent the early stages of some single species of the order: knowledge of the life-cycles is still incomplete.

Two families, one of which includes only fossil forms, are recognized. Six recent genera are known, two of them being represented in our waters.

Family SQUILLIDAE.

a. Carapace and first five abdominal somites with longitudinal carinae .. .. *Squilla.*

aa. Carapace and first five abdominal somites without longitudinal carinae .. .. *Lysiosquilla.*

SQUILLA (Fabricius).

The larva of a member of this genus is shown at fig. 18; this kind of larva was once referred to the genus *Alima*, and is now known as a larva of the *Alima* type: all *Alima* larvae represent young stages of some *Squilla* or other. This slender-bodied immature form differs strikingly from the adult figured below: the long and slender rostrum of the broad, spiny carapace is not hinged: only the two anterior pairs of thoracic limbs are developed; the first are slender and the second stout and raptorial; the first five pairs of pleopods are prominent, but the fifth is very small.

Four easily separated species have been recorded:—

a. Raptorial finger with four teeth, including the longest terminal one .... *miles.*

aa. Raptorial finger with six teeth, including the longest terminal one.

b. Telson without longitudinal ridges on each side of the median dorsal ridge.

c. Lower margin of raptorial propodus produced at distal end as a stout tooth .. .. *laevis.*

cc. Lower margin of raptorial propodus rounded at distal end, without tooth .. .. *oratoria inornata.*

bb. Telson with longitudinal ridges on each side of the median dorsal ridge .. .. *fasciata.*

Martial Mantis-shrimp. *Squilla miles* (Hess). (a soldier).

The colour is yellowish above, thickly covered with tiny, blackish dots, so that the ground colour appears olivaceous; the ridges and spines are marked with black, and there is a narrow black line around the edge of the carapace and rostrum: there is a curved black marking on each side of the dorsal segments of the thorax and abdomen.

This species was at one time considered rare, being known from only very few specimens: recent investigations have shown that it is fairly common in St. Vincent Gulf, and that examples from there were described by Professor Ralph Tate 60 years ago under the name *S. pectinata*. Specimens are sometimes thrown up on the sandy beaches of the Gulf after storms, single examples usually being obtained in this way: it has also

been dredged in shallow water off St. Kilda, in the Gulf. After a severe storm in 1920 a number of adults were picked up on the beach at Glenelg, they having been possibly killed by the increased influxion of fresh water due to the exceptional floodwaters of that winter: from these circumstances it would appear that the species inhabits shallow water at no great distance from the shore. So far as the writer is aware it has never been observed alive, but it is evident that the large limbs used for catching prey would, as in some allied species, also form an excellent defensive weapon.

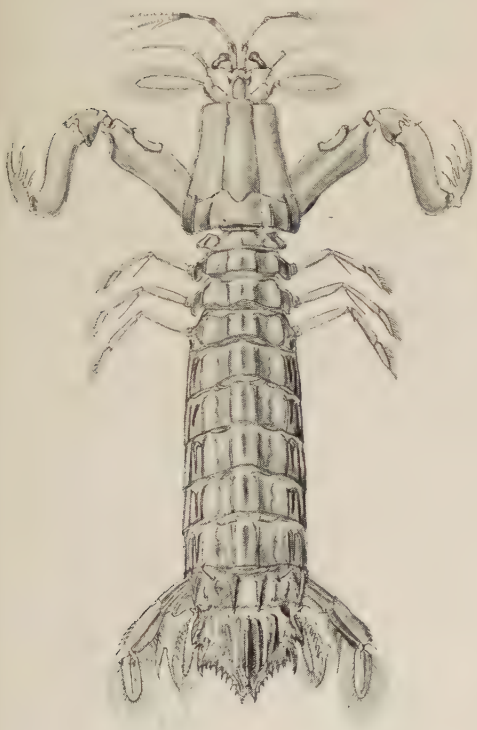


FIG. 19.—*Squilla miles* (⅔ nat. size).

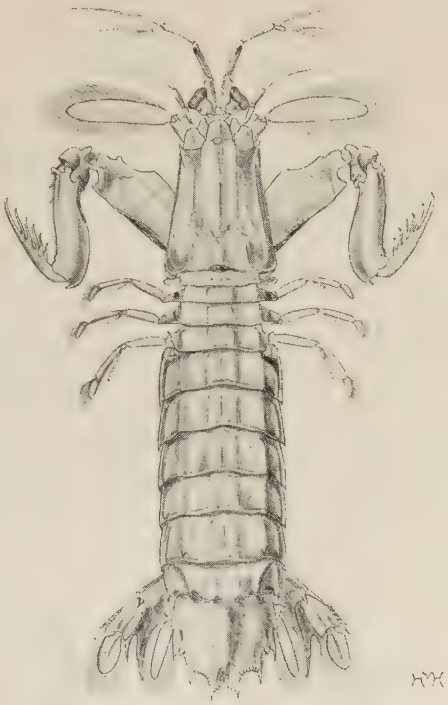


FIG. 20. *Squilla laevis* (⅔ nat. size).

In addition to the characters commonly distinguishing the sexes of members of the order, "secondary" sexual distinctions are apparent in large males of this mantis-shrimp: in these the propodus of the raptorial limbs is wider and stouter than in females of the same size, while the carinae are inflated, and the short ridges at the bases of the marginal denticles of the telson are almost globose. Further structural details may be gleaned from the figures illustrating the characters of the order. The type, which was taken in New South Wales, is the largest recorded example, but some South Australian specimens are 6in. in length.

Length: 172 mm., or 6¾in. (S.A.M.)

Smooth Mantis-shrimp. *Squilla laevis* (Hess). (smooth).

The known range of this form is from New South Wales to South Australia: the tooth at the lower apex of the raptorial propodus is characteristic. The ground colour is yellow, with the dorsal ridges, the spines and punctures of the telson, and the posterior margins of the segments of the body black; the uropoda bear a black longitudinal marking: the hinder part of the carapace, and of the thoracic and first five abdominal segments are faintly banded with closely-set black dots. Length: 120 mm., or $4\frac{3}{4}$in. (S.A.M.)

Banded Mantis-shrimp. *Squilla fasciata* (de Haan). (banded).

This species has faint, transverse bars of darker colour on at least part of the upper surface, hence the specific name. It is a rare form, and a

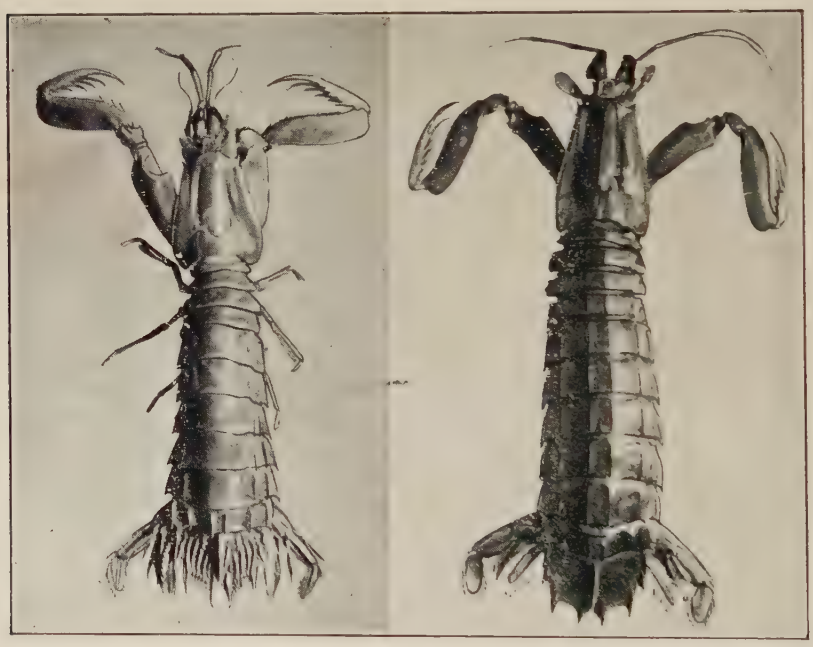


Fig. 21.—*Squilla fasciata* (nat. size). Fig. 22.—*Squilla oratoria inornata* ($\frac{1}{2}$ nat. size.

single specimen from St. Vincent Gulf constitutes the only record of its occurrence in Australian seas. *S. subfasciata* (Tate) in a synonym. Length: 68 mm., or about $2\frac{3}{4}$in.

Plain Mantis-shrimp. *Squilla oratoria inornata* (Tate). (unadorned).

A mantis-shrimp found in China, India, and Australia, but seldom taken in our waters. The absence of ridges on each side of the middle carina of the telson distinguishes this form and *S. laevis* from our other two species. The abdomen and part of the thorax are greenish in life, while the spines of the uropoda and telson, and the outer side of the raptorial merus, are reddish. Length: 107 mm., or $4\frac{1}{4}$in. (S.A.M.)

LYSIOSQUILLA (Dana).

The body is smoother, and the somites are more loosely articulated than in the previous genus. The species excavate deep burrows in the sand, sometimes digging to a depth of three or four feet: the great flexibility of the body enables the animal to completely reverse its position in a narrow tunnel. Kemp captured alive a species occuring in India and northern Australia, and observed that: "When laid on its back it would rapidly assume a normal position by turning its anterior extremity upwards and backwards and creeping along its own body." In regard to the defensive capabilities, the same writer remarks: "When picked up, the specimen attacked the fingers of its captor with both ends of its body simultaneously, striking out vigorously with its raptorial claws and at the same time endeavouring to make wounds with the spinous armature of its telson and uropods." Some of these Mantis-shrimps captured by myself in northern Queensland behaved in precisely the same way.

During a visit to New Ireland some years ago Mr. Edgar R. Waite made an interesting note concerning the use of the spiny, raptorial finger of a large mantis-shrimp (*Lysiosquilla maculata*) as a burglar deterrent by the natives. The ground outside a hut, containing valuables, is thickly planted with the claws, points uppermost; a native approaching with felonious intent has his enthusiasm effectively cooled on receiving the spines in the soles of his bare feet!

The young of the *Lysiosquillae* are known as *Lysioerichthys* larvae. The three forms recorded from South Australia are characterised as follows:—

a. Raptorial finger with five teeth. Hinder edge of telson thick and deeply sculptured.. .. .. *perpasta.*

aa. Raptorial finger with eight to twelve teeth. Hinder edge of telson thin.

b. Raptorial finger with eleven to twelve teeth .. .. *vercoi.*

bb. Raptorial finger with eight to nine teeth .. .. *osculans.*

Plump Mantis-shrimp. *Lysiosquilla perpasta* (Hale). (well-fed).

A plump species, which is easily recognized by the curious sculpture of the posterior margin of the telson. The colour of the single described specimen, which was taken from Kangaroo Island, is yellow, with the raptorial limbs, the carapace, and parts of the remainder of the upper surface covered with minute brown dots; these spots are absent on the head and its appendages, and on the rostrum. Length: 57 mm., or 2¼in. (S.A.M.)

Verco's Mantis-shrimp. *Lysiosquilla vercoi* (Hale). (personal name).

A form dredged by Sir Joseph Verco, near Robe, on the South-eastern coast. The ground colour is yellowish, with a few large black chromatophores (colour cells) on the upper surface, the appendages of the head, and on the

raptorial merus and carpus; the rostrum and lateral portions of the carapace are marked with small white rings. Length: 42.5 mm., or 1 $^{11}/_{16}$in. (S.A.M.)

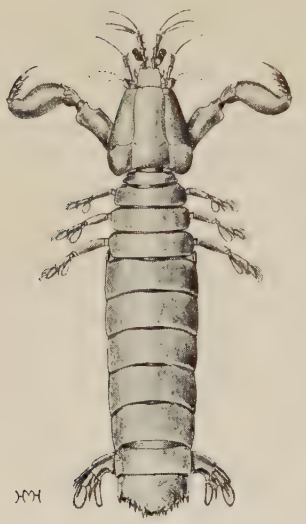


Fig. 23.—*Lysiosquilla perpasta* (nat. size).

Fig. 24.—*Lysiosquilla vercoi* (x 1½).

Fig. 25.—*Lysiosquilla osculans* (x 2).

Slender Mantis-shrimp. *Lysiosquilla osculans* (Hale). (kissing).

Very like the foregoing species, but distinguished by having a lesser number of teeth on the raptorial finger, and by the more evenly arranged spines on the hinder edge of the telson. The black chromatophores of the upper surface are in parts massed to form an indefinite colour pattern, as shown in the figure. Length: 38 mm., or 1½in. (S.A.M.)

Chapter IV.—Order DECAPODA. The Prawns and Shrimps.

The Decapoda is the largest and most important of the orders of Crustacea. It receives practically all of the larger species, and includes our most familiar forms—the crabs, shrimps, prawns, lobsters, crayfish, and so on.

A member of the order is, as a rule, easily recognized. A large carapace covers the thoracic somites, and at the sides wholly conceals the gills. The eyes are stalked, and the first three pairs of thoracic appendages are modified as maxillipeds, and are more or less adpressed and directed mouthwards; the remaining five pairs of thoracic limbs are usually (though not invariably) very conspicuous, and are conveniently termed the legs. This ten-footed feature is responsible for the name of the order.

In the basal segment of the first antennae of most Decapods there is a sac furnished with plumose hairs, and usually containing one or more little bodies known as "otoliths." This organ, the "statocyst," is connected with the balance of the animal when swimming; the sac is sometimes open to the exterior, and the "otoliths" consist of introduced grains of sand; in other cases it is closed, and an otolith is formed in the cavity by secretion.

Although all Decapods have the above characters in common, the order embraces such a varied assortment of species that a good deal of further subdivision is necessary. The ten-footed crustaceans fall into two groups, or sub-orders, the Natantia, or "swimmers," which are dealt with in this chapter, and the Reptantia, or "creepers" (Chap. v.-vi.); the names refer to the usual locomotive habit of the members of each group.

Respiration.—With the exception of one genus, all Decapods are equipped with gills, which lie in a cavity on each side of the thorax. The means by which the Murray Lobster maintains a current of water through the branchial chamber and over the gills is explained in Chapter II.; this system, in which water enters along the lower edge of the gill-chamber and passes out at the sides of the mouth is typical of the condition in the long-tailed Decapods: modifications of the arrangement, such as are found in the crabs, are described in place.

Reproduction and Development.—In the majority of the Decapods the ova are small, and the young, when first hatched, are minute and undergo a more or less complicated series of changes before attaining the adult form. All species, however, do not hatch as "larvae," and, as previously indicated, in some cases the eggs are large, and the juveniles emerge at an advanced stage of development; instances in which the metamorphosis is almost wholly suppressed are found in at least the families Potamobiidae, Parastacidae, Crangonidae, Paguridae, Axiidae, Majidae, Dromiidae, and Potamonidae.

Suborder NATANTIA.

The swimming Decapods are those which are familiar to most people as prawns and shrimps: all are of somewhat similar appearance; the body is almost always compressed, with the thorax elongate; the abdomen is long, and is extended or more or less geniculate. The exoskeleton is rather thin, and sometimes fragile. The basal segment of the first antennae is usually produced on the outer side into a lobe or spine, termed the "stylocerite," and the scale or acicle (exopod) of the second antennae is generally very large: as a rule, the anterior part of the carapace is produced forwards in

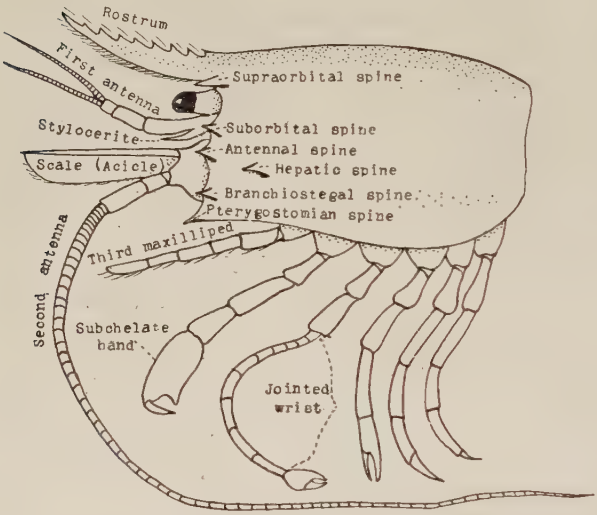


FIG. 26.—Cephalothorax of an imaginary prawn.

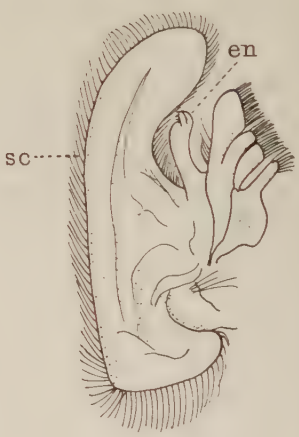


FIG. 27.—Second maxilla of *Peneus latisulcatus*; en., endopod, or palp; sc., scaphognathite (x 2½)

the form of a thin, compressed rostrum, one or both edges of which are often serrated. The pelagic prawn shown in fig. 30 is a typical representative; the pleopods are here well developed swimmerets, which are the main means of progression: this last feature is in contrast to that of the second suborder, for there the pleopods are relatively smaller, and are not greatly used for swimming. The terminology of the spines and other parts of the cephalothorax is given in fig. 26.

The suborder is divided into three tribes, two of which are represented in our waters:—

a. Third pair of legs chelate . . . . . PENEIDEA (Free-swimming Prawns).

aa. Third pair of legs not chelate . . CARIDEA (Prawns and Shrimps).

Tribe **PENEIDEA.**

Two families are recognized:—

a. Gills many. Last two pairs of legs well developed.. .. PENEIDAE.

aa. Gills few or none. Last two pairs of legs reduced or altogether absent.. .. .. LEUCIFERIDAE.

Family PENEIDAE.

The large pelagic prawns have the first three pairs of legs chelate, thus differing from the members of the following family and from any of the representatives of the next tribe (Caridea): they are esteemed as food, but are rarely seen in the Adelaide markets. The two species of which we have specimens from our State apparently do not occur here in any great number. In the year 1900 Japan exported dried prawns to the value of more than £20,000.

Respiration.—Fig. 27 shows the second maxilla of *Peneus latisulcatus;* the exo- and epipod of this appendage together form the scaphognathite which lies in the exhalent opening, and fans the water out of the gill chamber.

Reproduction and Development.—The genital openings of the male are found in the articular membrane between the basal joint of the last pair of legs and the sternum; in this sex the inner rami of the first pair of swimmerets are developed as curious membranous appendages, which are often of large size, and are hooked together on the median line, forming a sort

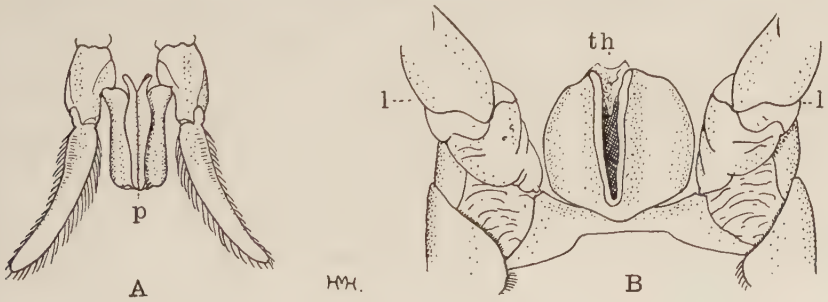


FIG. 28.—*Peneus latisulcatus.* A, first pair of swimmerets of male; p., "petasma" or male sexual organ: B, sternum of last thoracic somite of female; l., bases of last pair of legs; th., "thelycum" or receptaculum seminis (x 2).

of curtain (petasma) from limb to limb (fig. 28 A). In the female the inner plate of this pair of pleopods is small or altogether absent; the oviducts open on the basal joint of the ante-penultimate pair of legs, and on the underside of the last thoracic somite outgrowths from the sternal surface form a receptacle (thelycum) for the spermatozoa of the male. The petasma of the male is apparently used to insert the spermatozoa in this

pocket, which varies slightly in shape in *Peneus latisulcatus;* the large posterior part of the thelycum of a female 9in. in length is shown in fig. 28 B.

The eggs are not carried about by the female, but are extruded freely into the water. The complete life-cycle has not been traced in any one species of the family, but certain observers have proved that the Peneids have more complete metamorphoses than any other of the Decapods: the young hatches in the form of a *Nauplius* (fig. 29), and passes through various

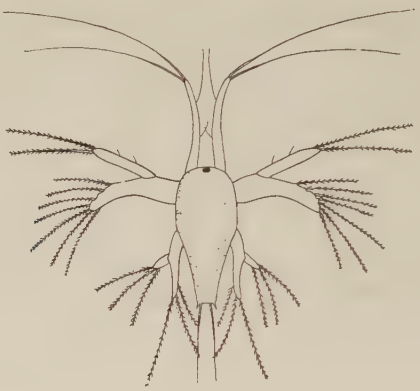


Fig. 29.—*Nauplius* larva of *Peneus* (after Muller, greatly enlarged).

degrees of this and *Metanauplius*, *Protozoea*, and *Zoea* stages before entering the last, or Schizopod-stage, in the later phases of which the animal approaches the adult form.

Two genera are represented in South Australian seas:—

a. Rostrum serrated on both upper and lower margins .. *Peneus.*
aa. Rostrum serrated on upper margin only .. .. *Penaeopsis.*

PENEUS (Fabricius).

Furrowed Prawn. *Peneus latisulcatus* (Kishinouye). (with lateral furrows).

This species belongs to a section of the genus having only one spine on the lower margin of the rostrum; there are from eight to eleven teeth on the upper margin. The dorsum of the carapace bears three long grooves, the median one being excavated in the crest behind the saw-edged rostrum. The telson has three pairs of small lateral spines. This widely distributed species is moderately common in our waters, and half-grown examples are occasionally sold in Adelaide fish-shops as "Shrimps." The prawn attains a length of more than nine inches; South Australian examples of this size have been taken, but smaller specimens are usually secured. A closely allied form

(the "Sand Prawn" of Sydney) is taken in large numbers at the mouths of New South Wales rivers, and is considered "delicious food." Length: 245 mm., or 9⅝in. (S.A.M.)

Fig. 30.—*Peneus latisulcatus* (½ nat. size).

PENAEOPSIS (S. Bate).

Musical Prawn. *Penaeopsis novae-guineae* (Haswell). (after New Guinea).

This is a much smaller prawn than the foregoing, and is rather rarely taken in our gulfs. The body is clothed with short hairs, and, during life, the colour is a delicate rosy pink. The species is noteworthy in that both sexes possess a stridulatory apparatus on each side of the posterior part of

Fig. 31.—*Penaeopsis novae-guineae* (x 2).

the thorax: the organs consist of a row of five to twenty vertical ridges, over which the anterior margin of the first abdominal segment rubs; the ridges are, as a rule, developed to a greater extent in the female than in the male. The accompanying sketch was made by Mr. Baker years ago, and represents a specimen secured in the Port River. Length: 95 mm., or 3¾in. (S.A.M.)

Family LEUCIFERIDAE.

LEUCIFER (M. Edwards).

The species of this genus are little, transparent pelagic animals, very thin, and appearing like ghosts of prawns. They differ from all other Decapods in having no gills. The legs are reduced to three pairs; the first two are not chelate, and the third terminate in a very imperfect chela. The abdomen is relatively very large, and the pleopods are well developed, the petasma of the adult male being conspicuous. The eggs, after extrusion, are feebly attached "in a loose bunch of twenty or so" to the last pair of legs.

Ghost Prawn. *Leucifer affinis* (Borradaile). (allied).

The body is elongate and attenuated, with a long neck and stout eyes; the illustration shows the general appearance of a male of this easily overlooked

Fig. 32.—*Leucifer affinis* (after S. Bate, x 8).

form, which occurs in the Atlantic, Pacific, and Indian Oceans, as a rule near land. A single example was captured at Victor Harbour some years ago. Length: 10 mm., or $^{2}/_{5}$in.

Tribe **CARIDEA.**

The Caridea have somewhat the general appearance of the Peneidae, but differ in having only the first two, instead of three, pairs of legs chelate; also, the first pleopods of the male never have the inner branch developed as a copulatory organ, and the females carry their eggs on the underside of the abdomen. A rostrum is usually present, but may be altogether absent; when developed, it is sometimes large and serrated, as in the pelagic prawns, or small and simple. The popular name Shrimp (meaning shrunken) is often used in a loose sense to include any of the small Crustacea; the term Prawn (which is of unknown origin) seems to have been applied to any of the larger Caridea with slender legs and long antennae, but neither name is definitely restricted to any one group.

Four of the seven superfamilies into which this tribe is divided are represented. Most of the South Australian species are of comparatively small size, the largest rarely exceeding six inches in length, and the smallest being

barely half an inch. As noted under the different families, considerable diversity of habit occurs in the group.

The colour-patterns of several of our species are so complicated, and in some cases change so rapidly during life, that it is impossible to adequately describe them; the variations of some of the little prawns inhabiting St. Vincent Gulf are amazing, and the rich colours of, for instance, members of the genera *Hippolyte, Latreutes, Tozeuma,* and *Pontophilus* excite the admiration of the most phlegmatic.

Reproduction and Development.—As in most other Decapod groups, the eggs, after extrusion, are attached to the swimmerets of the female, and thus carried about until they hatch: as far as is known, none of the Caridea hatches at an earlier stage than a *Zoea,* while many of them develop much further before emerging from the egg. The females of one of the smaller Snapping-prawns (*Synalpheus*), occurring in certain sponges in St. Vincent Gulf, bear very large, greenish eggs, and the young hatch in the *Mysis* (or Schizopod) stage.

The superfamilies are separated as follows:—

a. First two pairs of legs similar, of moderate size .. OPLOPHOROIDA.
aa. First two pairs of legs more or less unlike.
  b. First legs never subchelate. Mandibles rarely simple.
    c. First two pairs of legs slender, the first either simple or minutely chelate .. .. PANDALOIDA.
    cc. First two pairs of legs chelate, never both slender, one of them often very large .. .. .. PALAEMONOIDA.
  bb. First legs often subchelate; mandibles always simple.. .. .. CRAGONOIDA.

Superfamily **OPLOPHOROIDA**.

a. Marine species with the fingers of the chelae not spooned and not tipped with tufts of hair .. .. .. CAMPYLONOTIDAE.
aa. Fresh-water species with the fingers of the chelae spooned and tipped with tufts of hair.. .. .. .. ATYIDAE.

Family CAMPYLONOTIDAE.

CAMPYLONOTUS (S. Bate).

Spiny-backed Prawn. *Campylonotus rathbunae* (Schmitt). (personal name).

The upper margin of the large, upturned rostrum is armed with two prominent teeth, behind which, on the median dorsal line of the carapace, are two more teeth; the lower edge of the beak is cut into three teeth. Both sides of the carapace are furnished with two short ridges, each terminating

anteriorly in a sharp spine (an antennal and a branchiostegal spine). The abdomen is curiously armed; the third, fourth, and fifth segments bear median ridges which project at the posterior ends of the somites in the form of sharp spines. On the third segment the median ridge is produced at the anterior third (as well as posteriorly), the first projection being tongue-shaped. The posterior border of the fifth segment bears two spines, and the sixth somite has a spine-like posterior projection, on each side. The sexes are much alike, but the male is lighter in build, and of smaller size, than the female. The species has been taken only in the Great Australian Bight, in deep water. Length: approximately 115 mm., or 4½in.

Family ATYIDAE.

PARATYA (Miers).

Fresh-water Shrimp. *Paratya australiense* (Kemp). (Australian).

A translucent species found in most of our creeks and rivers, and at times particularly plentiful in the backwaters of the River Murray; it is sometimes thought by boys to be the young of the common Yabbie. The two pairs of pincer limbs have the fingers tipped with brushes of hair. This little

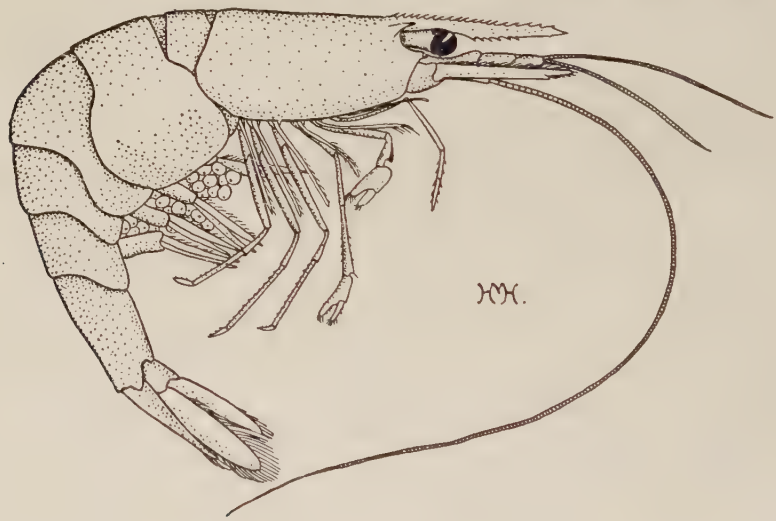


Fig. 33.—*Paratya australiense* (x 4).

shrimp is edible, and is quite palatable, but is not much valued as food owing to its small size and the difficulty of obtaining it in sufficient number. Length: 25 mm., or 1in. (S.A.M.)

The Yabbie, Murray Crayfish, River Prawn (*Palaemon*) and this small shrimp are the only long-tailed Decapods found in fresh-water in South Australia: in the three first-named one of the first two pairs of thoracic limbs is much enlarged.

Superfamily **PANDALOIDA.**

Family PANDALIDAE.

Here are included some slender-legged marine prawns, which have the wrist, or carpus, of the second pair of legs subdivided, so that more than the normal number of articulations appears in these limbs. The "Pink Shrimp," familiar to Londoners, is a member of the family. Two genera are represented:—

a. First four pairs of legs with epipods . . . . . *Plesionika.*

aa. Thoracic legs without epipods . . . . . *Parapandalus.*

PLESIONIKA (S. Bate).

Soldier Prawn. *Plesionika martia* (M. Edwards). (martial).

A widely distributed prawn, which has been trawled in deep water in the Bight. The carapace is furnished with a long rostrum, which has five teeth above, and is very finely-serrated below, the tiny lower teeth being almost concealed by a fringe of short hairs. The wrist of the second legs is multi-articulate, and is provided with a terminal brush of stiff hair, while the chelae of this pair of limbs also bear tufts of hairs. The life colour is pink, the eggs being light blue. Length: 115 mm., or 4½in.

PARAPANDALUS (Borradaile).

Slender-beaked Prawn. *Parapandalus leptorhynchus* (Stimpson). (slender beak).

A delicate, semitransparent prawn, often taken in the dredge. The slender rostrum, armed with comparatively few and feeble teeth, is a distinctive feature. The beak varies in length, and in a variety taken in the

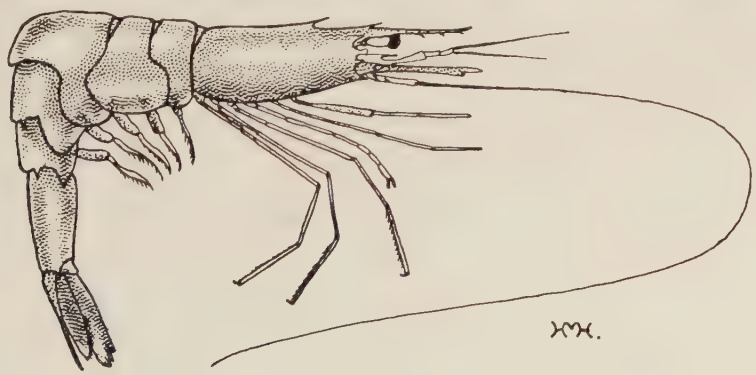


Fig. 34.—*Parapandalus leptorhynchus* (x 3).

Bight, and later at Port Adelaide also, is much longer than in the specimen illustrated, which is from St. Vincent Gulf. The legs are slender; the wrist of the second pair is divided into only three joints. Length: 25 mm., or 1in. (S.A.M.)

Hunch-back Prawn. *Parapandalus leptorhynchus gibber* (Hale). (a hunch-back).

A variety which has so far been found only in St. Vincent Gulf. The abdomen, in addition to being strongly geniculate, is elevated dorsally, hence the name. Length: 31 mm., or about 1¼in. (S.A.M.)

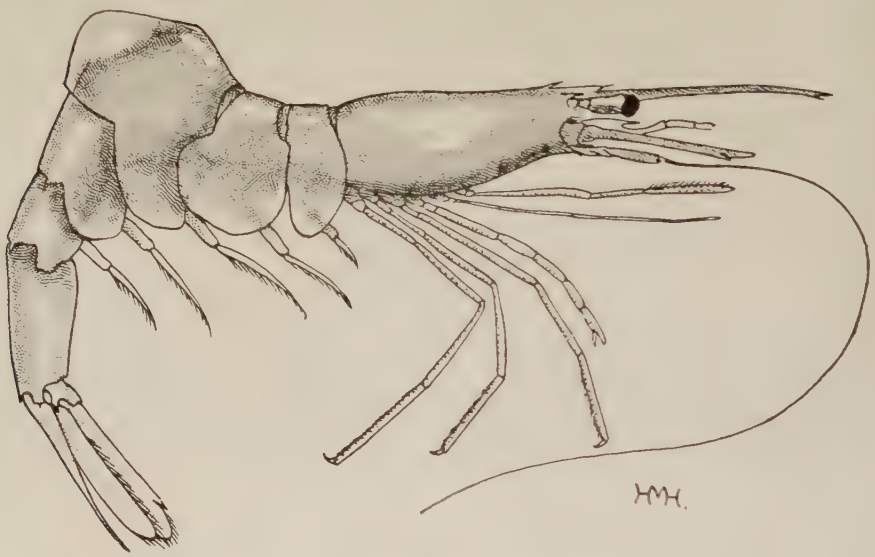


Fig. 35.—*Parapandalus leptorhynchus gibber* (x 3½).

Superfamily **PALAEMONOIDA.**

Four families are represented in our seas and rivers:—

a. Wrist of second pair of legs subdivided.
  b. First pair of legs much larger than others.
    Eyes covered by carapace .. .. SYNALPHEIDAE.
  bb. First pair of legs not much larger than others.
    Eyes not covered.. .. .. HIPPOLYTIDAE.
aa. Wrist of second pair of legs not divided.
  c. Rostrum hinged, movable .. .. RHYNCHOCINETIDAE.
  cc. Rostrum not hinged, rigid .. .. PALAEMONIDAE.

Family SYNALPHEIDAE (Snapping Prawns).

In the genera mentioned below, the semi-transparent front region of the carapace is curiously modified, extending over and, usually, quite enclosing the eyes; the eye-hoods are sometimes rounded in front and sometimes produced into a spine:—

a. An acute rostrum present.
  b. Basal article and spine of first antennae short .. .. *Crangon.*
  bb. Basal article and spine of first antennae long.
    c. First pair of chelipeds more or less symmetrical .. *Athanus.*

cc. First pair of chelipeds more or less asymmetrical, one of them of abnormal form, at least in the male ..... *Synalpheus.*

aa. No rostrum, but carapace somewhat angularly rounded in front ..... *Betaeus (australis)*

CRANGON (Weber).

Anyone who has visited our mangrove swamps or reefs at low tide cannot fail to have heard the sharp clicks made by the Snapping-prawns; the sound is produced by the snapping together of the fingers of the large chelae, which have a remarkable peg and socket arrangement (fig. 36). The name *Crangon* was, until comparatively recently, applied to a genus of prawns now known as *Crago*, and the animals under discussion were widely known

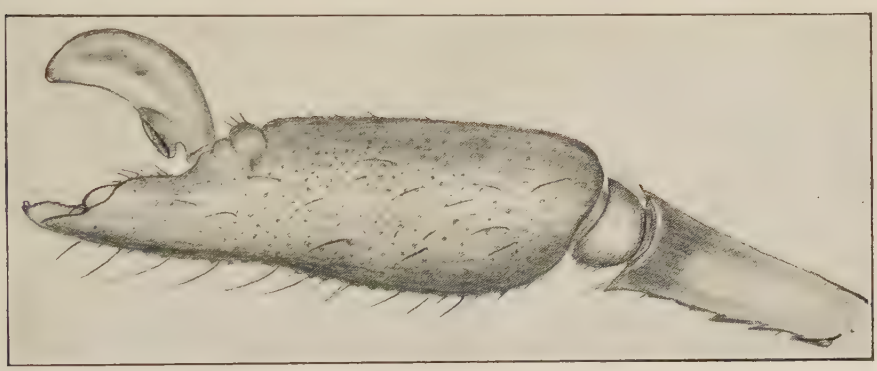


Fig. 36.—Large cheliped of *Crangon novae-zelandiae* (x 3).

as *Alpheus*. The species noted below occur in the shallow waters and on the reefs of St. Vincent and Spencer Gulfs. They lurk in narrow cracks and holes on the reefs, and at low tide specimens may be secured by pouring weak formalin over spots where the clicking is heard; after a time the prawns crawl out from their retreats; they readily part with their large chelae when grasped, but specimens killed slowly in very dilute formalin remain intact.

a. Eye-hoods each with an acute spiniform projection.

b. Merus of third and fourth legs with an acute tooth at anterior end of lower margin. Body hairy .. *villosus.*

bb. Merus of third and fourth legs without such tooth. Body smooth ..... *socialis.*

aa. Eye-hoods more or less rounded in front, without spine,

c. Merus of third legs with an acute tooth at anterior end of lower margin ..... *praedator.*

cc. Merus of third legs without such tooth.

d. Larger chela with both upper and lower margin emarginate and with grooves or depressions on sides ..... *edwardsi.*

dd. Larger chela with margins entire except for a small transverse groove near articulation of movable finger . . . . . *novae-zelandiae*

These species may be readily separated during life by their distinctive colour patterns.

Shaggy Snapping-prawn. *Crangon villosus* (Olivier). (shaggy or rough).

One of the commonest of our Snapping-prawns. During life it is semi-transparent, with the thorax and abdomen lemon yellow, the latter with a few small red spots on sides: the large chelae are orange, with yellow

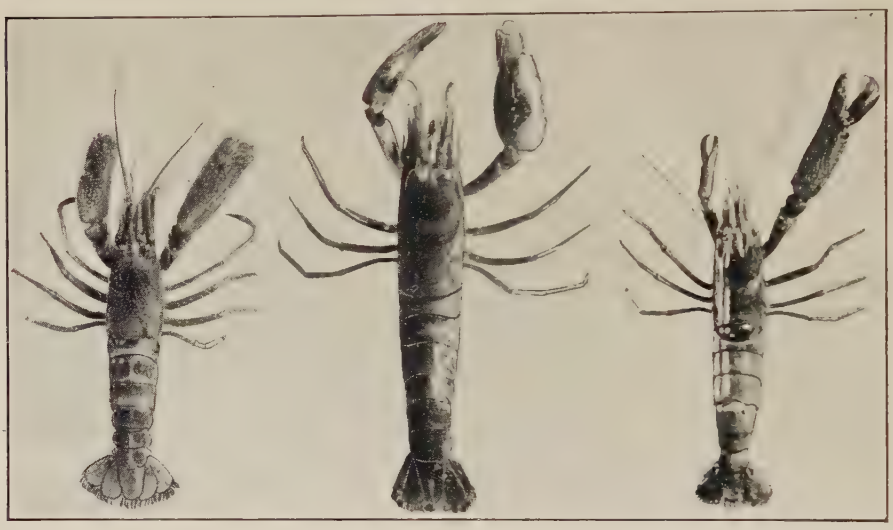


FIG. 37.—*Crangon villosus* (½ nat. size).

FIG. 38.—*Crangon socialis* (x 1¼).

FIG. 39.—*Crangon novae-zelandiae* (½ nat. size).

granulations, and the flagella of both pairs of antennae are banded with dark red. The colouration and the hairy clothing (to which the specific name alludes) at once distinguish the species. Length: 67 mm.; or 2¾in. (S.A.M.)

Smooth Snapping-prawn. *Crangon socialis* (Heller). (allied).

A small and a large variety occur, the latter being found on reefs near shore, the former being taken in the dredge in deeper water (5 to 10 faths.): both varieties differ from the typical form in having the first joint of the wrist of the second legs a little longer than the sum of the two following. The small variety is illustrated; the life colours of the figured specimen were as follows:—Marked with various shades of purplish-red and with tail fan red; large chela with three pale cross bands on upper edge and with fingers salmon pink. Length: small var. 29 mm., or 1⅛in.; large var. 50 mm., or 2in. (S.A.M.)

Mottled Snapping-prawn. *Crangon praedator* (de Man). (a plunderer or hunter).

A beautiful species during life, marked with large mottlings. It differs from our other forms in having a flat tooth on each side between the rostral carina (which is interrupted) and the eyes; the carina on the anterior part of the carapace is bounded on each side by a shallow groove. This prawn is difficult to capture, as it swims rapidly to another retreat when disturbed. Length: 67 mm., or $2\frac{3}{8}$in. (S.A.M.)

Banded Snapping-prawn. *Crangon edwardsi* (Audouin). (personal name).

The curious grooving and emargination of the large chela is a salient feature. South Australian specimens belong to a variety of the species differing from examples from the east Australian coasts in not having a spine at the apex of the infero-internal margin of the merus of the larger cheliped. Living examples from our waters have the upper side of the carapace green, tinged with brown, and the abdomen banded with green above; the tip of the tail-fan is blue: the chelae are green above, white tinged with blue below, and the inner surface of the fingers is marked with yellow: the underside is white. Length: 44 mm., or $1\frac{3}{4}$in. (S.A.M.)

New Zealand Snapping-prawn. *Crangon novae-zelandiae* (Miers). (after New Zealand).

The character of the large chela distinguishes this from the foregoing species. This prawn is common near shore; when alive it is green, purplish, or blue, with white mottlings and spots; each branch of the uropods has a white marking: the palms of the chelae are spotted with white, or bear yellow markings, on the upper side; the fingers of the large chela are tipped with orange, their outer margins are the same colour, and the inner margins are yellow. Length: 67 mm., or $2\frac{3}{8}$in. (S.A.M.)

ATHANUS (Leach).

The first pair of legs are not unsymmetrical as in *Crangon* and *Synalpheus*, and, as a rule, the beak is longer. Two species have been recorded from South Australia.

a. First pair of legs with wrist and hand directed forwards, and merus short . . . . . *granti.*

aa. First pair of legs with wrist and hand directed backwards, and fitting into a groove in the long merus *haswelli.*

Grant's Prawn. *Athanus granti* (Coutière). (personal name).

In this and the three following species Coutière has associated the names of Australian carcinologists. The original descriptions of these species are not available in our libraries.

Haswell's Prawn. *Athanus haswelli* (Coutière). (personal name).

The dactyli of the last three pairs of legs are simple, whereas in the preceding species these joints have two distinct terminal claws. (S.A.M.)

SYNALPHEUS (S. Bate).

Small and beautifully coloured prawns which are often found in sponges. As in the preceding genus only two species have been noted from our waters, but others occur.

a. Merus of third leg stout, less than four times as long as wide .. .. *bakeri.*

aa. Merus of third leg rather slender, more than four times as long as wide .. .. *maccullochi.*

Baker's Prawn. *Synalpheus bakeri* (Coutière). (personal name).

May be separated from the following form by the characters given in the key.

McCulloch's Prawn. *Synalpheus maccullochi* (Coutière). (personal name).

The females bear relatively large eggs and the larvae hatch at an advanced stage of development. Length: 20 mm., or $\frac{3}{4}$in. (S.A.M.)

BETAEUS (Dana).

Beakless Prawn. *Betaeus australis* (Stimpson). (southern).

The absence of a beak at the front of the carapace separates this small prawn from the other South Australian representatives of the family. It is apparently somewhat rare on our coasts. The life colouration of some specimens taken on one of our reefs was as follows:—Upper surface rich purplish-brown; sides and tips of uropods white. The colour of New South Wales examples has been described as green. Length: 25 mm., or 1in. (S.A.M.)

Family HIPPOLYTIDAE.

Includes an assortment of queer prawns, many of which are gaily coloured. The rostrum is always well developed, and is often long and conspicuous. The mandible may have an "incisor process" and palp, or may be without either or both. The first legs terminate in rather small chelae, while the second pair have small pincers, and have the wrist subdivided into joints, sometimes into only three segments, sometimes into ten or so. The next two families of the Caridea differ from this and the preceding family in having only one joint in the wrist.

The accompanying diagram (fig. 40 A) shows the parts of the mandible referred to in the key. The mandible of *Latreutes* which lacks both palp and incisor process, is shown at B in the same figure.

a. Wrist of second legs at least seven-jointed. Mandible with a three-jointed palp .. .. *Alope*

aa. Wrist of second legs three-jointed. Mandible without palp.
  b. Mandible with incisor process .. .. *Hippolyte.*
  bb. Mandible without incisor process.
    c. Body stout; lateral process of basal segment of first antennae rounded anteriorly .. .. *Latreutes.*
    cc. Body very slender; lateral process of basal segment of first antennae pointed anteriorly .. .. *Tozeuma.*

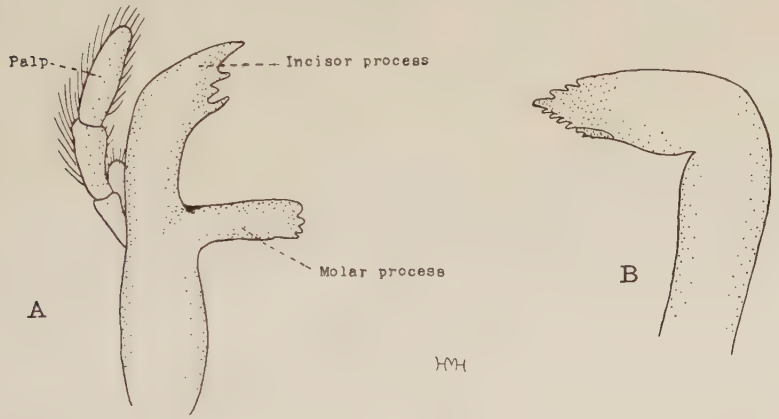


FIG. 40.—A, mandible of one of the Caridea, showing incisor process, molar process, and palp; B, mandible of *Latreutes* (incisor process and palp absent).

ALOPE (White).

The mandible has a distinct three-jointed palp, but the incisor process is small or obsolete.

Bald Prawn. *Alope australis* (Baker). (southern).

The body is rather short and robust; the colour is whitish, marked with darker spots and bars. The wrist of the second legs is divided into seven

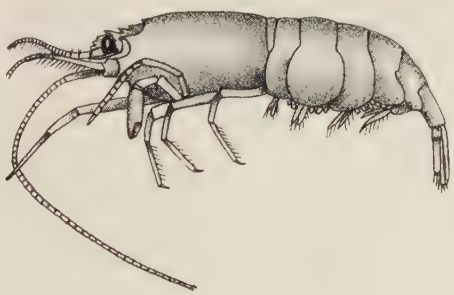


FIG. 41.—*Alope australis* (after Baker, x 2).

to ten segments. The rostrum is rather short, does not reach to the level of the anterior end of the basal articles of the first antennae, and has four to seven teeth on the upper margin. The type specimens were obtained

in shallow water at Kangaroo Island, and the species has since been discovered near the shores of St. Francis Island, South Australia, and in the waters of New South Wales and lower Burma. Length: 27 mm., or $1\ ^1/_{16}$in. (S.A.M.)

HIPPOLYTE (Leach).

At least some species of this genus change their colouration at will. Investigations concerning the colour changes show that in one species the tint may range from reddish to yellow-green, green, brown, blue, and black. An almost black example became transparent and practically colourless in a few minutes when placed in a white bowl, and a brown specimen changed to green when placed in a jar covered with muslin. The same species more slowly adapted itself to the colours of sea-weed with which it was associated. The changes are produced by the expansion and contraction of different sets of colour elements or "chromatophores" controlled by the nervous system; these chromatophores lie not only under the epidermis, but between muscle fibres and in the internal organs.

The mandible has a distinct incisor process, but no palp. Two species occur in our waters.

a. Rostrum moderately deep, not toothed on upper margin *australiensis.*
aa. Rostrum more slender, with three teeth on upper margin . . . . . *tenuirostris.*

Weed Prawn. *Hippolyte australiensis* (Stimpson). (Australian).

Specimens captured when feeding on weed are green, pleasingly marked

Fig. 42.—*Hippolyte australiensis* (x 5).

with brown. In dorsal view the rostrum is wide at the base; it has no teeth on the upper margin, but on the lower side is produced into a thin keel which is cut into two to six teeth. On each side of the base of the

rostrum is a small spine which overhangs the bases of the eye-stalks. The upper surface of the telson bears two pairs of spines (the first pair situated in front of the middle of the length) and some apical spines. The middle segment of the wrist of the second legs is much shorter than the first or third, and the third joint is longer than the first. The prawn occurs also on the east and west coasts of Australia; the largest South Australian specimen is 25 mm. in length. Length: 38 mm., or 1½in. (S.A.M.)

Little Prawn. *Hippolyte tenuirostris* (S. Bate). (slender-beaked).

The adults are smaller than in the other South Australian species, and differ in having the rostrum more slender, with two to three teeth (almost always three) on the upper margin, and one or two on the lower edge near

Fig. 43.—*Hippolyte tenuirostris* (x 8).

the apex; sometimes the ventral rostral teeth are absent. Also, the third segment of the abdomen, particularly in preserved specimens, is rather more humped. The Little Prawn may be dredged in weedy patches in St. Vincent Gulf, and is sometimes taken in company with *H. australiensis* on the Port Willunga, Marino, and other reefs. Length: 12 mm., or nearly ½in. (S.A.M.)

LATREUTES (Stimpson).

The mandible has neither incisor process or palp (fig. 40 B), and the rostrum is subject to great variation.

Green Prawn. *Latreutes truncifrons* (S. Bate). (mutilated in front).

A curious little prawn which lives amongst the sea-grasses in the Gulf and which, like *Crabyzos* and many other small crustaceans found in this weed, is usually yellowish-green or green, admirably matching the colour of its environment. The female, a figure of which is given, is far more commonly taken than the male. In this sex the rostrum has the appearance of being cut off in front, a character alluded to in the name *truncifrons:*

it is considerably variable in shape, and its front margin does not always form a right angle with the upper edge, but is often more or less oblique: also, the serrations of the anterior edge may be even and acute, jagged and irregular, or almost or quite absent: the single spine on the dorsal margin may be behind or in advance of the eye-level. The upper surface of the

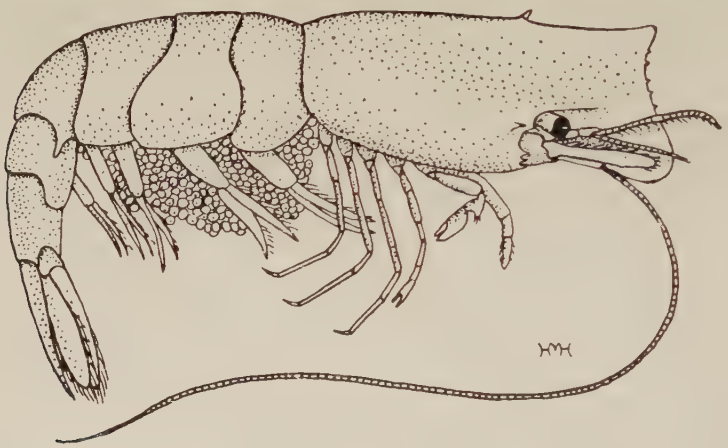


Fig. 44.—*Latreutes truncifrons* (x 5).

carapace is often smooth, but may have several incisions set with tufts of hairs; the abdomen is, in such examples, also clothed with hair-tufts dorsally.

The male differs markedly from the female: it is much more slender, with the swimmerets stouter: the upper flagellum of the first antennae is very much thicker and longer, and the rostrum is of entirely different shape, greatly resembling the blade of a razor. Length: 20 mm., or about ¾in. (S.A.M.)

TOZEUMA (Stimpson).

The rostrum is long and dagger-like, and the body is slender. As in *Latreutes* the mandible lacks both incisor process and palp. Our four species may be separated as follows:—

a. Body smooth.
  b. Rostrum very long, with its keel cut into numerous small teeth
    c. Abdomen strongly curved and only slightly geniculate at third segment. First segment of wrist of second legs subequal in length to third .. *elongatum.*
    cc. Abdomen geniculate at third segment. First segment of wrist of second legs shorter than third *kimberi.*
  bb. Rostrum shorter, not much longer than rest of carapace, with its keel cut into only four to seven teeth .. .. *pavoninum.*
aa. Body and appendages clothed with short, stiff hairs *tomentosum.*

Slender Prawn. *Tozeuma elongatum* (Baker). (elongate).

The rostrum is slender and is very long, being one and one-half times as long as the remainder of the carapace; its ventral keel is cut into at least sixteen teeth, and sometimes more than thirty are present. This and the following form have a more elongate body than our other species of the

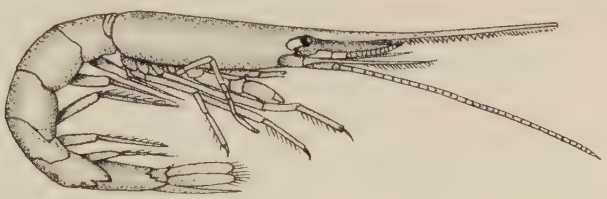


Fig. 45.—*Tozeuma elongatum* (after Baker, x $1\frac{1}{2}$).

genus. The predominating colour of a living specimen was reddish, and there was a slaty-back, circular marking, margined with bright yellow, on the fifth segment of the pleon. Length: 50 mm., or 2in. (S.A.M.)

Kimber's Prawn. *Tozeuma kimberi* (Baker). (personal name).

Unfortunately, the available specimens of this species have the rostrum damaged, but it is evidently very long normally; its keel is cut into numerous crowded teeth. In a specimen observed alive, the carapace and first four abdominal segments were green, marked with blue and red dots; a broken series of blue dots extended on each side from the rostrum to the

Fig. 46.—*Tozeuma kimberi* (after Baker, x $1\frac{3}{4}$).

middle of the length of the abdomen. The rest of the abdomen, and the tail-fan were blood-red; there was an ocellus (centrally black) on each side of the fifth abdominal segment, and a dark spot at the end of the inner branch of the uropods. Length: 45 mm., or about $1\frac{3}{4}$in. (S.A.M.)

Peacock Prawn. *Tozeuma pavoninum* (S. Bate). (coloured like a peacock's tail).

A brilliantly-coloured species during life; described as being of a rich green, between apple and malachite, darker on the back; the rostrum is crimson anteriorly and yellow on the upper part of the posterior half: a

yellow stripe, variegated with blue markings, extends along each side of the carapace: the abdomen has a yellow marking on each side of the first three segments; the lower parts of the first five segments are purple, shading into rosy violet, and the telson and uropods are crimson. On each side is an eye-like spot near the top of the third abdominal segment, and another

Fig. 47.—*Tozeuma pavoninum* (after Baker, x 1½).

on the lower part of the first and fifth segments: in a freshly-caught specimen these markings "rivalled in brilliancy those of a peacock's tail; the centre was filled with intense peacock-blue and green, surrounded by a black ring, then one of crimson scarlet." The deep keel of the rostrum bears four to seven small teeth. Length: 64 mm., or 2½in. (S.A.M.)

Hairy Prawn. *Tozeuma tomentosum* (Baker). (clothed with short hairs).

A long-beaked prawn easily recognized by its dense clothing of short

Fig. 48.—*Tozeuma tomentosum* (after Baker, x 2).

hairs. The rostrum is about as long as the remainder of the carapace, and its ventral keel bears five teeth. Length: 40 mm., or 1 $^{9}/_{16}$in. (S.A.M.)

Family RHYNCHOCINETIDAE.

RHYNCHOCINETES (M. Edwards).

The members of this genus have the large rostrum hinged to the front of the carapace, a character which is not found in our other Decapods. In this and the next family the wrist of the second legs is not divided as in the two preceding families of the Palaemonoida.

Hinge-beaked Prawn. *Rhynchocinetes rugulosus* (Stimpson). (rather rough).

Somewhat rare in South Australian waters, but occasionally found in crevices and beneath stones on our reefs. Some examples taken in St. Vincent Gulf were marked with lines as shown in the photograph, but the colour is changeable. A specimen recently observed was at first semi-transparent with the lines dark green, bordered with paler colour, the last three segments had a brilliant yellow marking on each side, uniting on the telson,

Fig. 49.—*Rhynchocinetes rugulosus* (nat. size).

and a median yellow line on the two penultimate segments: the tail-fan was marked with blue, with orange marginal hairs: the rostrum was dark blue on upper half, bright yellow on ventral part: the antennal scales were marked with blue and yellow, and the antennal flagella were reddish. The ground colour later changed to violet, and the lines became dark purple. In another phase the ground is dark purple and the lines vivid blue. The surface of the exoskeleton is roughened with many subparallel striae, which are often set with short hairs. Length: 57 mm., or 2¼in. (S.A.M.)

Family PALAEMONIDAE.

The first pair of chelipeds are generally considerably smaller than the second. Our species are placed in two closely-related subfamilies which are separated as follows:—

a. No gill above base of third maxillipeds .. .. Pontoniinae.

aa. A large gill above base of third maxillipeds.. .. .. .. Palaemoninae.

Subfamily Pontoniinae.

Many of the members of this subfamily live as commensals with other marine animals; some dwell in bivalve molluscs, others shelter in sponges, anemones, sea-urchins, corals, sea-squirts, and so on. They are often

brightly coloured, and it has been noted that in this respect some forms harmonize excellently with their hosts. Only three species, referable to separate genera, have so far been taken off our coasts.

a. Rostrum with conspicuous teeth .. .. *Periclimenes*

aa. Rostrum without teeth.

b. Rostrum depressed (and with a ventral keel) .. .. *Pontonia.*

bb. Rostrum laterally compressed in distal half .. .. .. *Anchistus.*

PERICLIMENES (Costa).

Aesop Prawn. *Periclimenes aesopius* (S. Bate). (classical name).

This prawn is free-living; it is remarkable in that a compressed hump projects backwards from the hinder part of the third abdominal segment; Aesop was a hunchback, hence the specific name. During life the thicker

Fig. 50.—*Periclimenes aesopius* (x 3).

(outer) lash of the first antennae is held perpendicularly, and the other flagellum horizontally forwards; the long feeler of the second antennae is directed backwards most of the time. The creature is extremely transparent and, were it not for a few colour markings, would be invisible when viewed in its native element; in the figure an attempt has been made to show the pattern of a living ovigerous female. On the upper side of the carapace and rostrum is a series of nine to eleven red dots (one at the base of each dorsal tooth), and behind these is a pair of looped red lines, enclosing a white marking: there are a few other small markings on the carapace: the legs and antennae are for the greater part banded or streaked with red: the large chelipeds are banded with lilac, and the pincer-claws are tipped with red: the first three abdominal segments bear a red line margining

the whitish dorsum, and have an ocellus and a red bar on the extremities of the pleural flaps: the base of the tail-fan is banded with brilliant red. Length: 25 mm., or 1in. (S.A.M.)

PONTONIA (Latreille).

The Pontoniae live in the mantle-cavities of bivalve molluscs or in the gill-cavities of sea-squirts.

Smooth Prawn. *Pontonia minuta* (Baker). (tiny).

A single specimen was dredged by Sir Joseph Verco in South Australian

FIG. 51.—*Pontonia minuta* (after Baker, x 4).

waters, but the exact locality and the host from which it was taken were not noted. Length: 11 mm., or $^{7}/_{10}$in. (S.A.M.)

ANCHISTUS (Borradaile).

Includes forms which, like some Pontoniae, live in the mantle-cavities of bivalve molluscs. As in *Pontonia,* the body is depressed and the spines of the carapace have almost all disappeared.

Pinna Prawn. *Anchistus inermis* (Miers). (unarmed).

A prawn found in the mantle cavity of *Pinna;* it has been taken from *Pinna inermis* in St. Vincent Gulf. The structure of the nippers of the first, or smaller, pair of chelipeds is very characteristic; each lower edge

52.—*Anchistus inermis* (after Miers, x 3)

is produced into a downwardly bent flap, so that the small chelae appear to be longitudinally excavated when seen from below. In living females "the entire body and legs are covered with minute white dots, and the eggs are pale straw, yellow, orange, or brown," while the male is transparent without white dots. Length: 39 mm., or about 1½in. (S.A.M.)

Subfamily Palaemoninae.

Represented in South Australia by three small marine prawns which live on or near the coast and one river prawn belonging to a very closely allied genus.

a. Marine species. Carapace with an antennal spine and a branchiostegal spine, but no hepatic spine .. .. .. *Leander.*

aa. Fresh-water species. Carapace with an antennal spine and an hepatic spine, but no branchiostegal spine .. *Palaemon.*

The positions of the spines referred to in the key are shown in fig. 26. at the beginning of this chapter.

LEANDER (Desmarest).

Little prawns which form a palatable dish; large examples of each of our three species attain a length of about 2in.

a. Branchiostegal spine placed well behind vertical level of antennal spine, and not overlapping front edge of carapace .. .. *intermedius.*

aa. Branchiostegal spine placed slightly behind vertical level of antennal spine, and overlapping front edge of carapace.

b. Wrist of second legs longer than palm. The two outer flagella of first antennae united for about one-third of length of thicker lash .. .. *serenus.*

bb. Wrist of second legs shorter than palm. The two outer flagella of first antennae united only at their bases .. .. *litoreus.*

Striped Prawn. *Leander intermedius* (Stimpson). (intermediate).

A species which is commonly taken by dredging in the gulfs or by sweeping a hand-net through weeds in shallow water. It is easily distinguished

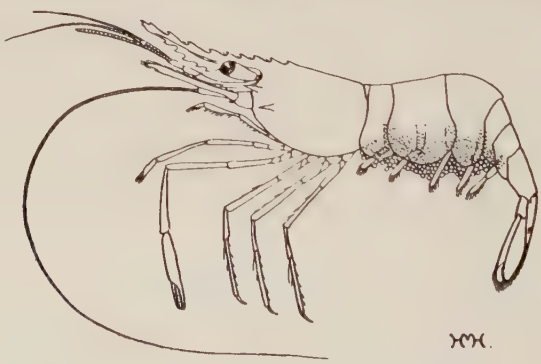


FIG. 53.—*Leander intermedius* (slightly enlarged).

from our other two members of the genus by the position of the branchiostegal spine. During life it is translucent, marked with narrow

red lines which on the abdomen are subparallel to the sutures. A note with one example collected many years ago states that a haul of these prawns taken by a boat belonging to the Fishing Company of South Australia in St. Vincent Gulf in 1885 were boiled in soft water and eaten with relish. Length, 60 mm., or 2⅜in. (S.A.M.)

Rock-pool Prawn. *Leander serenus* (Heller). (bright or fair).

If scraps of meat or crushed shell-fish are dropped into quiet shore pools numbers of these common prawns will appear, often in company with Gobies, Shore-eels, and other small littoral fishes. At Port Willunga the prawns dispute the possession of food with Blennies which live in holes in the sides of the rock-pools, snatching with the large nippers a morsel from

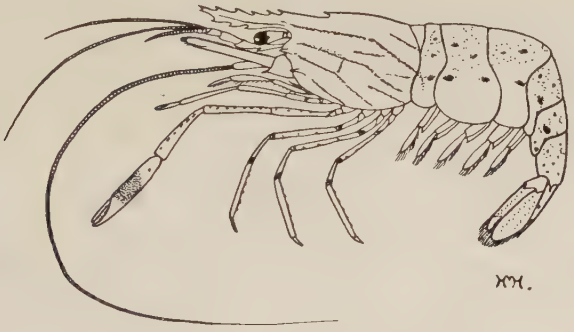


Fig. 54.—*Leander serenus* (slightly enlarged).

under the nose of a fish. If weedy patches on sheltered reefs are poisoned the species appears in clouds. During life it is glassily translucent; the carapace is marked with oblique red lines, and the abdomen is spotted or flecked with red. Residents of Kangaroo Island have used this species as food. Length: 60 mm., or 2⅜in. (S.A.M.)

Shore Prawn. *Leander litoreus* (McCulloch). (of the shore).

This form is apparently much rarer than the two foregoing species. It

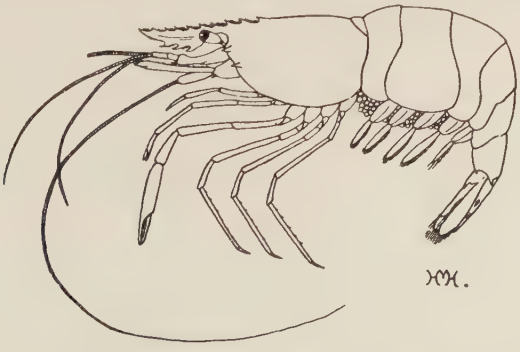


Fig. 55.—*Leander litoreus* (slightly enlarged).

is occasionally found in rock-pools in company with *L. serenus*. Length: 45 mm. or 1¾in. (S.A.M.)

PALAEMON (Fabricius).

Some of the River Prawns of tropical rivers grow to a length of a foot or so, and where abundant they are highly esteemed as food.

River Prawn or Long-clawed Prawn. *Palaemon australis* (Ortmann). (southern).

This species and the Fresh-water Shrimp (*Paratya*) are the only two prawn-like forms occurring in our rivers. The Long-clawed Prawn is readily distinguished from the last-named by the large second pair of pincer-limbs: varieties (which, perhaps, should be regarded as separate species)

Fig. 56.—*Palaemon australis* (nat. size).

of this prawn range over almost the whole of Australia, and in the northern areas attain a large size. The illustration shows a specimen of the average size taken in South Australian rivers; the creatures are almost transparent during life, with in some cases the fingers black. Length: 178 mm., or 7in. (S.A.M.).

Superfamily **CRAGONOIDA**.

a. Rostrum compressed. One of first pair of legs simple, the other chelate . . . . . PROCESSIDAE.

aa. Rostrum not compressed. Both legs of first pair sub-chelate. . . . . CRAGONIDAE.

Family PROCESSIDAE.

PROCESSA (Leach).

The characters mentioned in the key to the two families enable this genus to be easily recognized. The second legs are minutely chelate, with the wrist very long and divided into a great number of small joints.

a. Body moderately robust. Chelate limb of first pair with merus about as long as wrist and hand together . . . . . *australiense.*

aa. Body slender. Chelate limb of first pair with merus longer than wrist and hand together . . . . . *gracile.*

Odd-footed Shrimp. *Processa australiense* (Baker). (Australian).

The chelate leg of the first pair is short and stout, and is on the right side; the left limb of this pair is simple and tapers to a sharp and narrow

Fig. 57.—*Processa australiense* (after Baker, x 2½).

dactylus. The eggs of the female are small and numerous. Length: 16 mm., or ⅝in. (S.A.M.).

Long-wristed Shrimp. *Processa gracile* (Baker). (slender).

The first pair of legs are both strong; the chelate limb is on the right side, and the left limb terminates in a short, curved dactylus. Both this

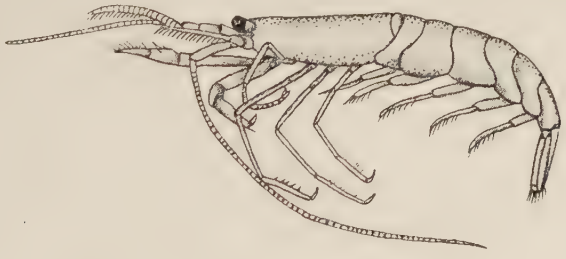


Fig. 58.—*Processa gracile* (after Baker, x 2½).

and the preceding species occur in St. Vincent Gulf. Length: 18 mm., or $^{11}/_{16}$in. (S.A.M.)

Family CRAGONIDAE.

The legs of the first pair are subchelate, and those of the second are rather feeble, with the wrist not divided. The rostrum is small, and usually flattened dorsally, and is not toothed. Species of two genera are known from our seas.

a. Eyes well separated. Second legs not chelate . . . . . *Vercoia.*

aa. Eyes set close together. Second legs chelate . . . . . *Pontophilus.*

VERCOIA (Baker).

Humped Shrimp. *Vercoia gibbosa* (Baker). (crook-backed).

A curiously sculptured shrimp, which has been dredged in from twelve to thirty fathoms. The eyes have very short stalks, and thus appear to be deeply sunk in the head. Seen in lateral view, the upper surface is very irregular, and the abdomen is conspicuously humped at the third segment. The female bears comparatively few eggs, which are relatively very large. Length: 17 mm., or $^{11}/_{16}$in. (S.A.M.)

PONTOPHILUS (Leach).

Pontophilus is closely allied to, and has much the general appearance of, *Crago*, a genus which includes the common shrimp of Europe, a species

Fig. 59.—*Vercoia gibbosa* (after Baker, x 3).

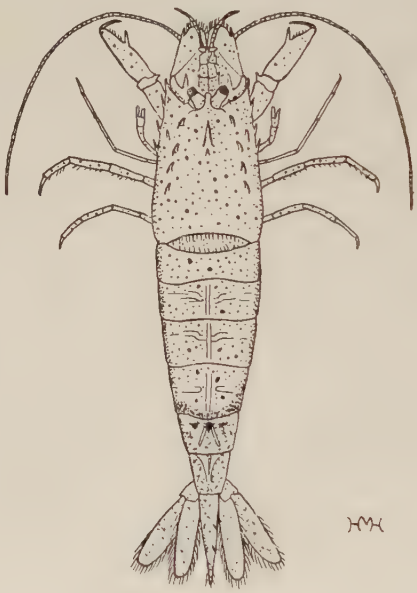


Fig. 60.—*Pontophilus intermedius* (x 1½).

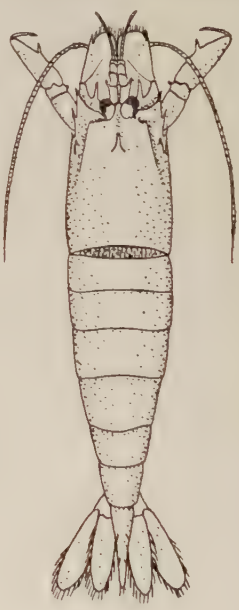


Fig. 61.—*Pontophilus flindersi* (x 2).

highly valued as food. It is stated that in London alone Shrimps to the value of £13,000 are sold on Sundays in the course of a year.

a. With a longitudinal row of four conspicuous teeth behind the suborbital spine .. .. *intermedius.*

aa. Without a row of conspicuous teeth behind suborbital spine .. .. *flindersi.*

Shrimp. *Pontophilus intermedius* (S. Bate). (intermediate).

The short rostrum has the upper surface concave. There is a spine at the outer angle of the orbit, posterior to which is a row of four similar teeth; the antero-lateral angles of the carapace bear a tooth, behind which are one to three (usually two) spines; between the two rows is an hepatic spine;

there is a median dorsal carina on the carapace, fading away posteriorly and cut into one large tooth anteriorly, sometimes with a smaller tooth behind the first. The abdomen bears a low median ridge. The species is exquisitely coloured during life. The cornea of the eyes is white, with a pale blue centre; the bases of the antennae and the upper surface of the first legs, of the carapace and of the abdomen, almost to the end of the fourth segment, are mottled in exact imitation of the pale grey sand of the Gulf bottom; the dorsum of the hinder part of the fourth abdominal segment is brilliant red, and on the anterior part of the fifth segment are three velvety black marks; the sides of the body, the remainder of the upper surface, and the legs and swimmerets are purple, reddish, or yellow, with numerous small dots. The eggs of the females are dull yellow. Length: 45 mm., or $1\frac{3}{4}$in. (S.A.M.)

A variety of this species (*P. intermedius victoriensis* Fulton and Grant) differs from the preceding only in having the dorsal carina of the carapace more distinct and cut into three teeth; these teeth may all be large, or the second and third may be much smaller than the first. The two varieties are taken together in St. Vincent Gulf.

Sand Shrimp. *Pontophilus flindersi* (Fulton & Grant). (personal name).

This shrimp is taken in shallow water on a sandy bottom; it greatly resembles the foregoing species in many respects. There is a depression behind the short rostrum, followed by a single median tooth; there is no row of spines behind the suborbital tooth, but on each side of the carapace is a ridge which curves inwards anteriorly and is continuous with the margins of the orbits and rostrum; behind the eyes this ridge is cut into four minute teeth. Length 35 mm., or $1\frac{3}{8}$ in. (S.A.M.).

Chapter V.—Order DECAPODA (contd.). The Lobsters, Crayfish, and Hermit Crabs, and their Allies.

Suborder REPTANTIA.

The crustaceans of this suborder have, in general, a creeping habit; nevertheless, some species swim strongly and well, but the pleopods are not the main locomotive organs, and the first five pairs may be reduced or absent. The exoskeleton is usually thick and calcareous and the body is rarely compressed, but is sometimes (as in crabs) much depressed; the rostrum of the carapace is often reduced or absent, and is never thin and saw-edged. The first antennae never have a stylocerite, and the scale of the second antennae is never large, but is generally small or absent. The legs are strong, and, as a rule, the first pair are larger than the others, and have the basis and ischium fused together; these two segments are never coalesced in the prawns and shrimps comprising the Natantia.

This suborder includes a much larger number of more varied forms than the first, and is separated into four sections, each of which contains one or more tribes.

a. Uropods usually present; when absent (one family only) the fifth pair of legs are slender and hidden in the gill chambers.

b. Third pair of legs of same character as first; last pair not markedly reduced in size. Abdomen long, extended, and heavily armoured.

c. None of first four pairs of legs chelate .. PALINURA (Sea-crayfish or Rock-Lobsters).

cc. First three pairs of legs chelate .. ASTACURA (Fresh-water Crayfish).

bb. Third pair of legs unlike first; last pair markedly reduced in size. Abdomen either bent upon itself or long and extended, but very soft and lightly armoured .. .. ANOMURA (Hermit Crabs and their allies).

aa. Uropods usually wholly absent; when vestiges are present (one tribe only) the last pair of legs are carried over the back. .. .. .. BRACHYURA (True Crabs: Chap. vi.).

Section **PALINURA.**

The Palinura includes two tribes; the species of one (Eryonidea) are blind, deep-sea forms, and have at least the first four pairs of legs chelate, but as none of them is recorded from our waters the characters of this tribe is not considered in the above key.

Tribe **SCYLLARIDEA.**

None of the legs is chelate in the male, but in some species the last pair bear small chelae in the adult female. The first abdominal somite is without appendages in either sex.

The larvae of the Scyllaridea have been known for a long time as Phyllosomas and, owing to their transparency, are popularly termed "glass-crabs"; at one time authors did not connect the glass-crabs with the Scyllaridea, but included them with the Mantis Shrimps in the Stomatopoda.

There are two representatives of the tribe in South Australia, and probably Adelaideans have a more intimate acquaintance with one of them than with any other of our crustaceans. The two species are extremely different in general appearance, and are assigned to separate families.

a. Thorax subcylindrical. Second antennae with a long, whip-like feeler .. .. PALINURIDAE.

aa. Thorax much depressed and flattened. Second antennae with flat scales instead of feeler .. .. SCYLLARIDAE.

Family PALINURIDAE.

This family embraces large edible crustaceans variously known as Spiny Lobsters, Rock Lobsters, Thorny Lobsters, and Sea Crayfish or Crawfish.

JASUS (Parker).

Southern Spiny Lobster, or Sea Crayfish. *Jasus lalandii* (M. Edwards). (personal name.)

The upper surface of the thorax is armed with numerous forwardly directed thorns. The first legs are stouter than the others; the ischium, merus, and propodus are each furnished with a strong spine on the inner edge, and the terminal part of the limb folds back like a jack-knife, forming a strong grasping apparatus.

The upper surface of the body is reddish-purple, here and there flecked and mottled with white, and on the abdomen with green also. The antennae are of the same colour, with the spines of the peduncle tipped with white,

while the flagellum is marked with four or five indistinct white annuli. The ridges of the legs are brick-red, the remainder reddish-purple, marked with white flecks; the claws are dull yellow merging into brown. The tail-fan is delicately shaded with umber across the middle of its length, merging into black posteriorly; there is a white spot on each side of the base

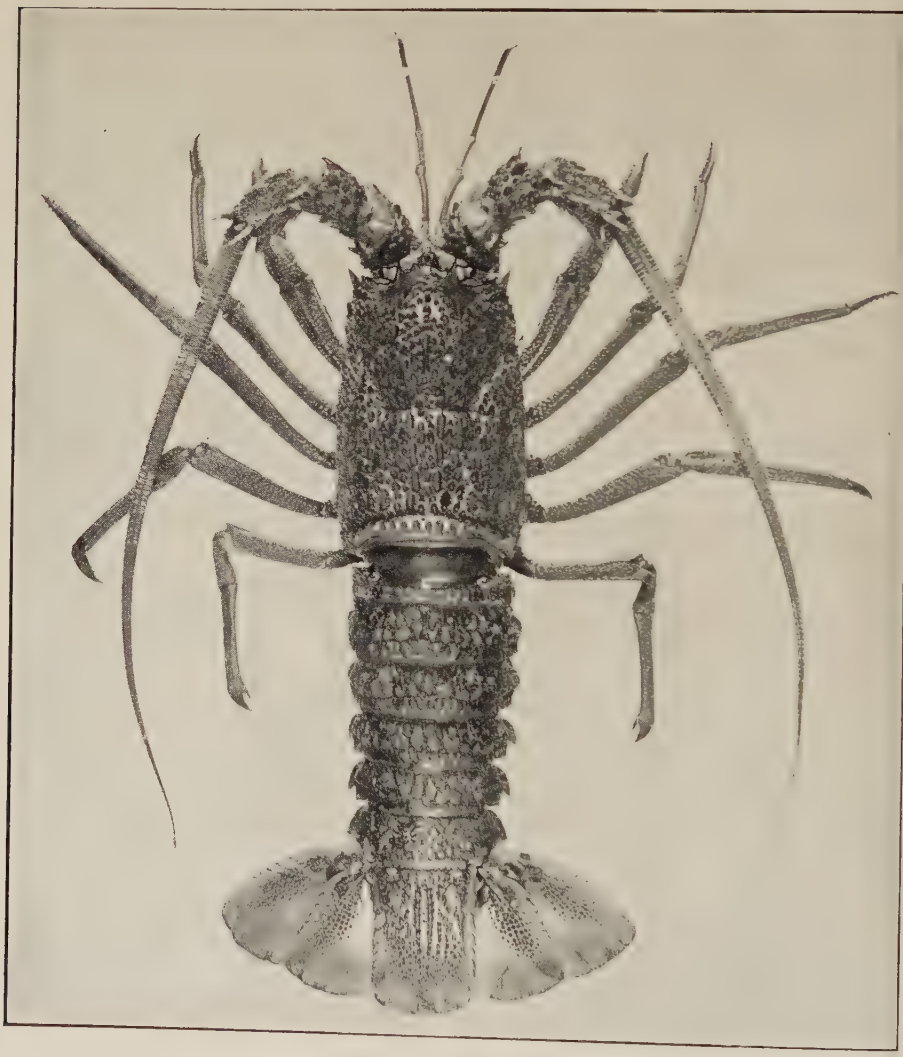


Fig. 62.—*Jasus lalandii*, female ($\frac{1}{4}$ nat. size).

of the telson. The side scutes of the telson and uropods are violet, and the thorns are for the most part reddish-purple tipped with brown. Length: 510 mm., or 20in. (S.A.M.)

A widely distributed species which is the common "Crayfish" or "Cray" of our fish-shops; about 832,000 individuals are sold in Adelaide

markets each year. Large specimens weighing 7lb. and more have been taken at Kingston, and it is claimed that an example which turned the scale at 10½lb. was captured at the Screw Pile jetty at Victor Harbour.

Fig.63.—Lobster trap, or cray-pot.

The Spiny Lobster is abundant on the southern seaboard, particularly in places where the bottom is rocky and affords good sheltering places, but it is rarely taken in St. Vincent Gulf. Some years ago fishermen liberated a crate of the crustaceans on the Port Willunga reef, but apparently they never became plentiful in the Gulf. For commercial purposes the animals are captured in baited traps, the well-known cray-pots of wicker or wire-work (fig. 63); the lobsters reach the bait by crawling to the opening at the top and dropping into the trap, but are prevented from creeping out

Fig. 64.—Floating cage for Spiny Lobsters.

by a cylindrical or funnel-shaped collar depending from the entrance hole. They are often retained for some time after capture in a submerged wooden cage (fig. 64), and are fed on fish offal and so on until required for market; octopi occasionally find their way into the pots and cages, being doubtless

attracted by the dainties intended for the crustaceans. At Beachport, on the south-eastern coast, the lobsters are captured on the reefs at the turn of the tide in baited hoop-nets.

The powerful legs and massive mandibles are capable of crushing hard bodies; the stomach of one large lobster contained broken fragments of the thick exoskeleton of a Boxfish (*Aracana*), while the crushed shell of a brother lobster was found in the stomach of another example, indicating that the

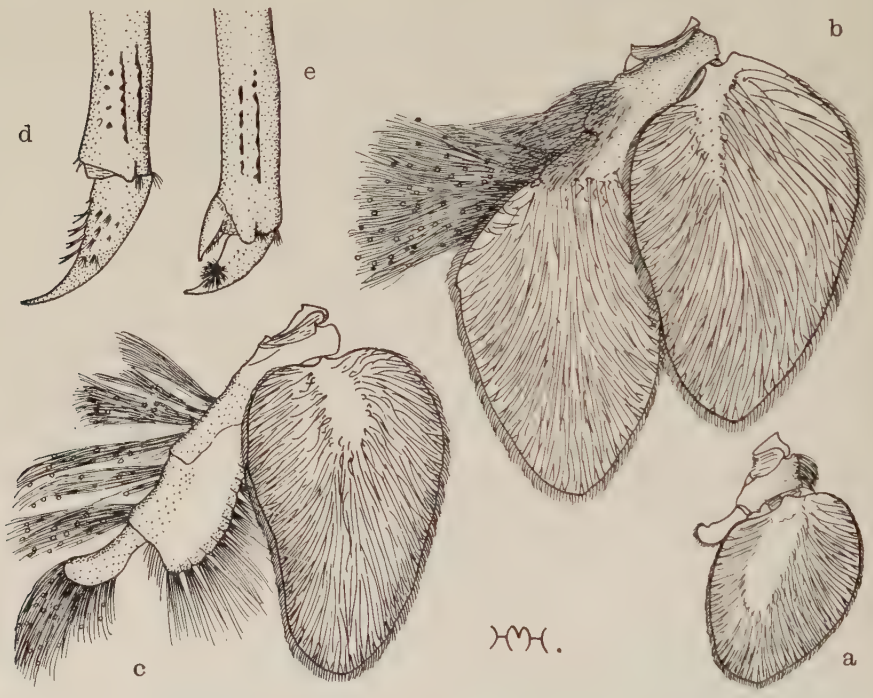


Fig. 65.—*Jasus lalandii*; a, first pleopod of male; b and c, first and second pleopods of female; d and e, terminal portion of last leg of male and female (all nat. size).

animals are cannibalistic at times: they are also undoubtedly scavengers. Remains of lobsters are sometimes found in the stomachs of various fishes, particularly leatherjackets; line fishermen are well aware that the flesh is relished by many fishes.

Reproduction and Development.—The genital openings of the male are situated on the coxae of the last pair of legs, those of the female on the coxae of the third pair of legs. Apart from the positions of these apertures, the adults of the sexes exhibit considerable differences and may be distinguished at a glance. In the male the four pairs of pleopods have only the outer branch well developed (fig. 65, a); in the female these appendages are very much larger and have both branches well developed.

Bunches of long hairs to which the eggs are attached emanate from the inner branch of the pleopods of the last-named sex; the two branches are similar in the first pair, but are very different in the others (fig. 65, b and c). Further, in the male, the last pair of legs end simply, but in the female a short, slightly movable process extends out from the inner side of the distal end of the propodus, in apposition to the dactylus, forming a small pincer (fig. 65, d and e). Doubtless, as in allied species, this little chela is utilised by the female to manipulate her ova. When working at night, fishermen readily separate the females by feeling for the propodal spur on the last pair of legs. It is probable that many sexually immature examples are taken before they have had opportunity of mating.

Spiny Lobsters have been observed mating in shallow water at Kangaroo Island in February and March; the eggs of a specimen under observation hatched in November. The ova are small, being only about three-fourths

Fig. 66.—*Naupliosoma* stage of *Jasus lalandii* (after Gilchrist, x 60).

of a millimetre in diameter, and a very great number is carried by the female. The newly-hatched larva is a curious little creature which swims at the surface, and has been named the *Naupliosoma* (fig. 66); the head region is very large, and contains a quantity of yellow yolk material. The thorax is narrow and unsegmented, and the abdomen is of insignificant size.

The first maxillipeds and fourth legs are represented by minute protuberances only, and there is no trace of the fifth legs. All other appendages of the head and thorax are developed; the large and hair-fringed second antennae are used for swimming. The *Nauplosoma* stage lasts only a few hours, when the animal moults and becomes a *Phyllosoma* larva, in which the body is glassily transparent (fig. 67); the antennae have lost their

Fig. 67.—*Phyllosoma* stage of *Jasus lalandii* (after Gilchrist, x 13).

natatory hairs, but the exopods of the now very much longer legs have acquired long setae, and are used for swimming. There are many successive series of the *Phyllosoma* stages, some of the more advanced of which have been taken in deep water.

Family SCYLLARIDAE.

The carapace is much wider than long, and is much flattened, with the lateral parts bent abruptly inwards towards the bases of the legs.

IBACUS (Leach).

Squagga or Prawn-killer. *Ibacus incisus* (Péron). (incised or notched).

The body is dull salmon-red; the carapace is faintly marked with darker spots, and the posterior four-fifths of the telson and the branches of the

uropods are yellowish. The broad and scale-like second antennae of this remarkable form are well shown in the illustration. Length: 210 mm., or 8¼in. (S.A.M.)

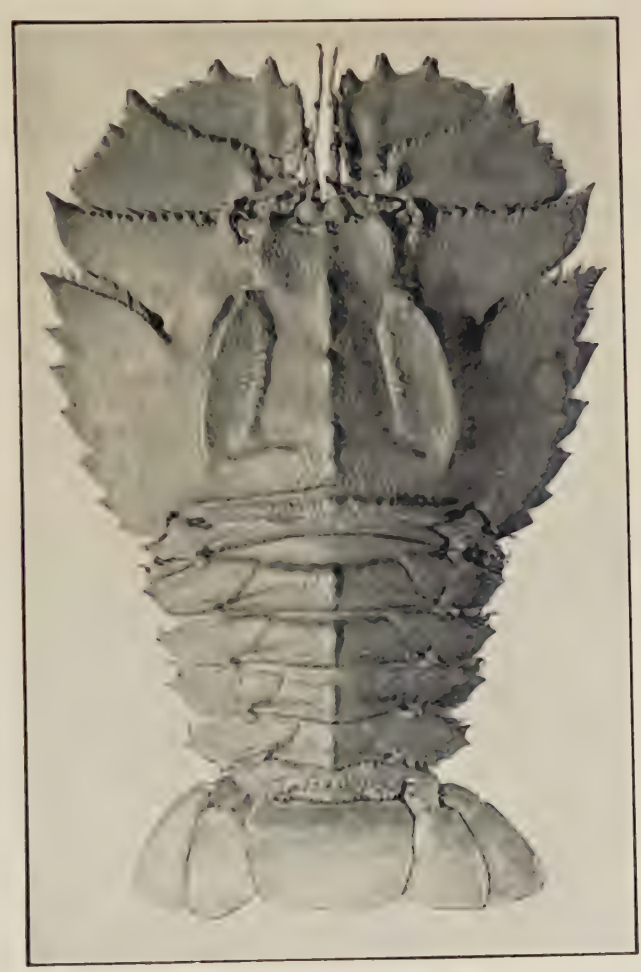


Fig. 68.—*Ibacus incisus* (½ nat. size).

Reproduction and Development.—The genital apertures are as in the preceding species; the pleopods of the male are narrow and biramous, and the last two pairs are small. In the female the abdominal appendages are much larger and bear long hairs to which the eggs are fastened. The last legs of adult females terminate in a small chela. An advanced *Phyllosoma* stage of this species has been dredged in St. Vincent Gulf; it is much like the late larval stages of the Spiny Lobster, but differs in having the second antennae scale-like.

Section ASTACURA.

This section embraces a single tribe, one of the three families of which has its headquarters in the fresh-waters of Australia. The large crushing chelipeds, followed by two smaller pairs of chelate limbs, distinguish the members.

Tribe NEPHROPSIDEA.

Family PARASTACIDAE.

The Southern Crayfishes differ from the fresh-water crayfishes of the Northern Hemisphere (Potamobiidae) and from the marine Lobsters of other countries (Homaridae) in not having appendages on the first abdominal somite in either sex.

In fresh-water crayfishes several discoidal nodules of limy matter are formed a little time before moulting; these are stored in the stomach, and are dissolved after moulting, apparently to supply some of the calcareous material necessary for strengthening the new integument (fig. 69). These

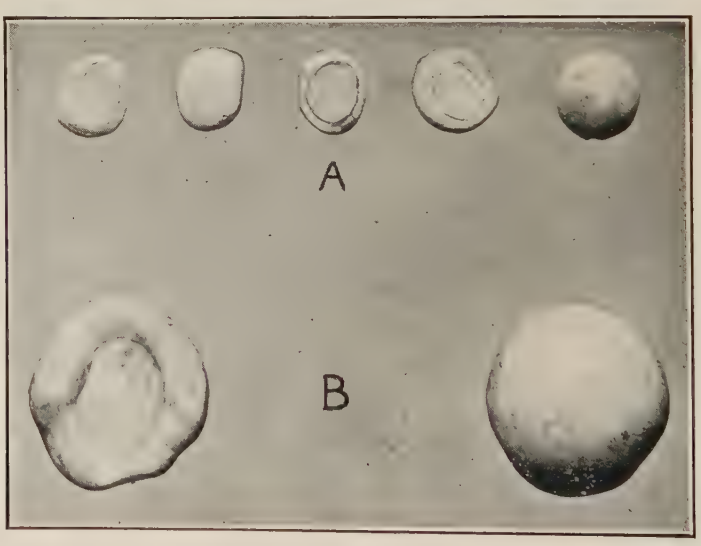


FIG. 69.—Gastroliths of (A) *Parachaeraps* and (B) *Astacopsis* (nat. size).

limy masses or "gastroliths" have a characteristic appearance, but often prove puzzling to persons who encounter them under circumstances giving no clue as to their identity. Some years ago a man found a number of Yabbie gastroliths in the excrement of shags, and recently two Murray Lobster gastroliths were taken from the stomach of a Murray Cod; the crustaceans in both cases were probably eaten soon after moulting, when

the gastroliths would be the only really indigestible parts. "Stomach-stones" were noted in the European crayfish a very long time ago; they were once popularly known as "crab's eyes" or "crab's stones," and were used in medicine for absorbent and antacid purposes.

The life-cycle of all fresh-water crayfishes is very different from that of their relations, the true or marine Lobsters, for instead of passing through a series of free-swimming larval stages, the young have a "direct" development, and on hatching present no remarkable differences from their parents.

Our two species, both of which are well known, are placed in separate genera.

a. Body smooth; lateral ridges of rostrum smooth and flat . . . . . *Parachaeraps.*

aa. Body armed with spines and tubercles; lateral ridges of rostrum tuberculate or spiny . . . . . *Astacopsis.*

PARACHAERAPS (Smith).

Yabbie, Yabber, or Crawlie. *Parachaeraps bicarinatus* (Gray). (with two ridges).

The rostrum has no high ridges and ends in a spine, below which are two small spines; the carapace is generally shallowly pitted, but has no other spines or tubercles. The chelipeds of large examples are almost as long as

Fig. 70.—*Parachaeraps bicarinatus* (½ nat. size).

the rest of the body. The colouration is very variable, and is usually similar to that of the environment. Some varieties are almost black, others are dark blue, delicate pink, reddish-yellow, pale olive, or greenish. Length: 180 mm., or 7in. (S.A.M.)

The Yabbie occurs in fresh-water streams and pools all over Australia, and is occasionally found in brackish waters near the coast. It often forms

a welcome addition to the commissariat of camping parties. The one-time extensive lagoons and backwaters of the River Murray in South Australia harboured the species in great number, but since the reclamation of Murray lands it is rare over such areas. It was, for a time, plentiful in the irrigation drains there, and was a source of considerable annoyance and expense owing to its persistent habit of burrowing into the earth barriers and banks. The River Murray aborigines found the Yabbie palatable, and Worsnop illustrated the method of capture adopted by them (fig. 71). This writer remarks: "The fisher puts between his teeth an ordinary rush bag, to hold the crayfish, which he first dislodges with his toes and then catches them with his hands, bagging them rapidly."

Fig. 71.—Aborigines fishing for Yabbies in the Murray (after Worsnop).

In arid districts the Yabbie burrows deeply into the mud, and so aestivates during dry spells. A dam at Freeling contains numerous Yabbies; it is often dry during the summer and the bottom becomes a baked desolation, covered with sun-cracks. At this time the crustaceans have been obtained three feet below the surface of the mud. During the drought year of 1913 the creatures were found in the dry bed of the Onkaparinga, enclosed in underground cells beneath large stones.

Reproduction and Development.—The male openings are situated on long, complicated papillae emanating from the coxae of the last legs; the female openings are on the last pair of chelate limbs (the third legs). The eggs, as in all species which have a direct development, are relatively very large. The young hatch out in mid-summer, and for a time cling to the swimmerets of their mother. Each little Yabbie is firmly attached by a special modification of the last two slender pairs of legs, which in the adult are walking limbs. In the young the dactylus of each of these legs has, on the inner margin, several spines, and terminates in a curved claw, which

in conjunction with one of the spines forms a veritable snap-hook, which clips to the hairs of the swimmerets of the parent (fig. 72, b). The mouth parts are much as in the adult, but the maxillipeds (fig. 72, c) lack the dense plume-like feeding hairs, which appear later. The carapace is greatly

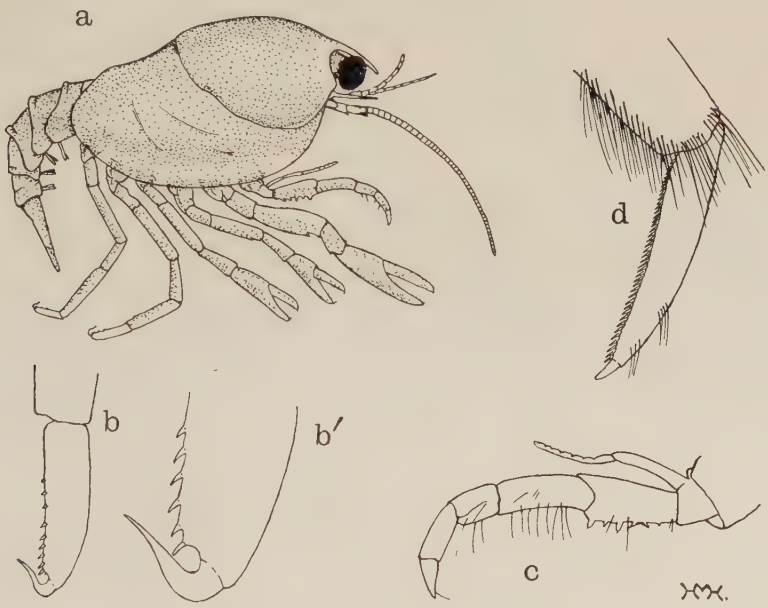


FIG. 72.—a, Young of *Parachaeraps* soon after hatching (x 12½); b, dactylus of walking leg, showing prehensile terminal claw (x 50); b′, terminal part of same dactylus (x 125½); c, third maxilliped (x 25); d, dactylus of small adult specimen for comparison. (x 12½).

extended with reddish-yellow food-yolk, which provides the youngsters with food until the first moult. The sixth segment of the abdomen lacks uropods, but these appear at the next moult.

ASTACOPSIS (Huxley).

The members of this genus live in running streams and, unlike the Yabbie, do not occur in isolated pools and dams.

Murray Crayfish or Murray Lobster. *Astacopsis serratus* (Shaw). (serrated).

Rostrum long, ending in a sharp spine and with lateral edges ridged and furnished with spines; carapace armed with sharp spines and tubercles; chelae and abdomen furnished with large spines.

The colour of a typical South Australian specimen is as follows:—Dorsum of cephalic part of carapace flesh colour and rostrum bluish; sides bluish faintly mottled with whitish and spines whitish. Dorsum of thoracic part of carapace greenish-blue and mottled with flesh colour; sides gray with tubercles white; anterior spines white, others tipped with white.

Abdomen greenish-blue, with a white marking at antero-lateral parts of third to sixth segments (where the somites overlap); the larger spines white, tipped with brown; telson with two oblique white markings near base; uropods and telson bluish basally, brown on posterior half. Large chelipeds bone white, the inner face of merus faintly marked with blue; the other legs bluish, with white spines. Eggs maroon to dark tan. Length: 305 mm., or 12in. (S.A.M.)

The spines and tubercles vary in number and disposition in different individuals. This crayfish is found in other rivers than the Murray, and its

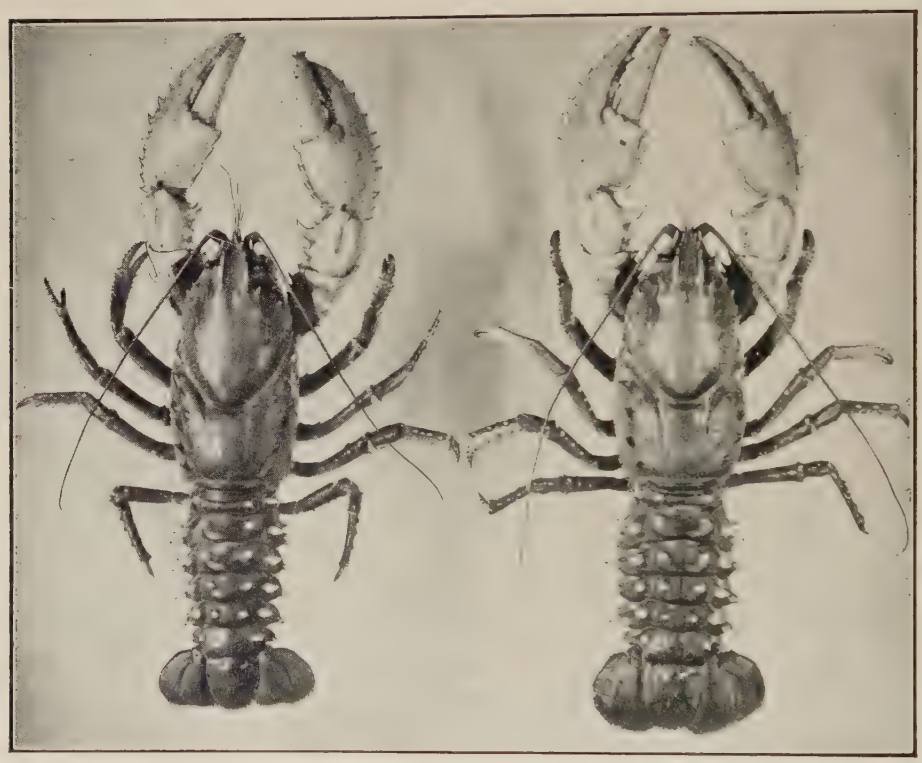


Fig. 73.—*Astacopsis serratus*, male and female (¼ nat. size).

varieties range from South Australia through Victoria and up the east coast to Sydney. The above description applies to typical South Australian specimens from the River Murray. A pinkish variety is said to have been taken in a deep creek in the extreme south-east of our State.

Settlers near the haunts of the Murray Crayfish sometimes use a baited hoop-net to secure examples for the table. From around the inside of the hoop hangs a fringe of hessian; a rabbit is thrown into the net, which is then lowered into the water and suspended with the bottom just resting on the river bed. The crayfish crawl up the sides and drop into the net to secure the bait, but when they attempt to crawl out, come up beneath the

curtain of hessian, and so cannot escape. The principle is the same as in the marine cray-trap. The flesh of the Murray Crayfish is esteemed as food, and there is little doubt that it would be profitable to breed it under control; such "farming" should be a comparatively easy matter owing to the simple life-cycle of the creature.

The late Prof. W. A. Haswell wrote on the inhabitants (parasites, etc.) of the gill-cavities of our fresh-water crayfish. He says: "An examination of the contents of the branchial chambers of Australasian fresh-water crayfishes has revealed an extensive and varied assemblage of animals that pass their entire lives in this sheltered position, and are never to be met with elsewhere." A mite (Acarid) described by this author occurs, sometimes abundantly, in the gill chambers of the Murray Crayfish.

Reproduction and Development.—The genital openings of the sexes are in the same positions as in the Yabbie. As shown in the illustration, the lateral margins of the abdomen, as seen in dorsal view, are more convex in the female than in the male. The remarks concerning the young of the Yabbie also apply here. In late summer a female has been observed with the young crawling freely all over her body, the little crayfish being then probably almost ready to abandon parental protection.

Section **ANOMURA.**

The salient characters of the crustaceans now to be described are given in the sectional key at the beginning of the chapter: four tribes of heterogenous families are recognized.

KEY TO TRIBES.

a. Last segment of second to fourth pairs of legs not flattened for shovelling.

b. Abdomen symmetrical; sixth abdominal appendages either styliform or modified for swimming.

c. Body depressed. Abdomen armoured and more or less bent under body .. .. GALATHEIDEA.

cc. Body compressed. Abdomen soft, long, and extended .. .. THALASSINIDEA.

bb. Abdomen almost always asymmetrical; sixth abdominal appendages neither styliform nor modified for swimming .. .. PAGURIDEA.

aa. Last segment of second to fourth pairs of legs flattened for shovelling.. .. .. HIPPIDEA.

Tribe **GALATHEIDEA.**

The last pair of legs are small, slender, and inbent. Species of two families are found in South Australia.

a. Abdomen not folded closely against underside of thorax . . . . . GALATHEIDAE.

aa. Abdomen folded closely against underside of thorax . . . . . PORCELLANIDAE.

Family GALATHEIDAE.

The carapace is elongate and is produced anteriorly into a prominent and sharply-pointed rostrum. The abdomen is bent, but is never adpressed to the body.

a. Rostrum broad and flattened, toothed on lateral edges *Galathea.*

aa. Rostrum slender and spine-like, without lateral teeth *Munida.*

GALATHEA (Fabricius).

Three small species of the little "Plated Lobsters," or "Craylets," of this genus occur in South Australia.

a. Rostrum with three teeth on each lateral margin.

b. Carapace with continuous striations across anterior part . . . . . *australiense.*

bb. Carapace with broken striations across anterior part *magnifica.*

aa. Rostrum with one tooth on each lateral margin . . . . . *pusilla.*

Striated Craylet. *Galathea australiense* (Stimpson) (Australian).

Commonly dredged in shallow water off our coasts. The carapace has the lateral margins furnished with seven or eight teeth; the striations run right across the body, and are fringed with hairs. The fingers of the chelae are much shorter than the palm. In living examples the cornea of the eyes is ruby-red, with a central black dot; the rostrum is pale and the general colour of the rest of the body varies from pink, red, brown, bluish, and pale grey, to very dark grey. The legs are banded with white, and the dorsum of carapace and abdomen bears white markings which apparently remain unchanged, but which are naturally more apparent in the darker phases; of these markings, one behind the eyes, one on each side, and one near the hinder edge of the carapace are most conspicuous. The eggs are yellow. Examples were observed to rub the last pair of legs over the upper surface of the carapace as if to clean it. In the illustrations of this and the next species the animals are shown in a natural position, with the

abdomen flexed, and also with the abdomen extended. Length: 15 mm., or $^{19}/_{32}$in. (S.A.M.)

Fig. 74.—*Galathea australiense* (x $2\frac{1}{2}$).

Scaled Craylet. *Galathea magnifica* (Haswell). (magnificent).

This form is more rarely met with. The fingers of the chelae are almost as long as the palm. The striations of the anterior part of the carapace are broken up into short, rounded scales, fringed with hairs; the lateral margins

Fig. 75.—*Galathea magnifica* (x $2\frac{1}{2}$.)

are armed with six to seven teeth. The difference in the sculpture of the two species is shown in the photographs.

The colour of typical examples is described as bright red, with a brilliant purple stripe down the middle of the carapace. The legs are marked with bands of red and purple, and the fingers are reddish-brown with yellow tips. Length: 15 mm., or $^{19}/_{32}$in. (S.A.M.)

Little Craylet. *Galathea pusilla* (Henderson). (very small).

Easily separated from our other two representatives by the form of the rostrum, which ends in a spine and has only one spine on each lateral margin, near the base. A single specimen was dredged in 75 fathoms between Beachport and the Althorps, apparently the only record of its occurrence in our waters. Length: 11 mm., or $^{7}/_{16}$in. (S.A.M.)

MUNIDA (Leach).

Differs from *Galathea* in having a styliform rostrum, with the spine on each side of its base long instead of short.

Long-armed Craylet. *Munida haswelli* (Henderson). (personal name).

A long-clawed form which has been taken off our southern coasts. The rostrum is about one-half the length of the carapace. The striae run across

Fig. 76.—*Munida haswelli* (x 2).

the carapace, and are granulate and fringed with hairs. There are spinules on the upper surface of the carapace, and each lateral margin is armed with six or seven small spines; the anterior margin of the second abdominal segment bears six to eight spinules. Length: 25 mm., or 1in. (S.A.M.)

Family PORCELLANIDAE.

The carapace is somewhat oval in shape, rather broad, with faintly-marked regions. The symmetrical abdomen is closely adpressed to the underside of the thorax, so that the animals look like little crabs; they have only three pairs of walking legs, however, and are thus readily separated from the true crabs. The "Porcelain Crabs" are usually found in shallow water, in sheltered situations, such as beneath stones on reefs, and, in accordance with their habit, are often much flattened. When alarmed some of the species exhibit a ferocious aspect which, considering their diminutive size, is ludicrous; they often part with their large claws when captured.

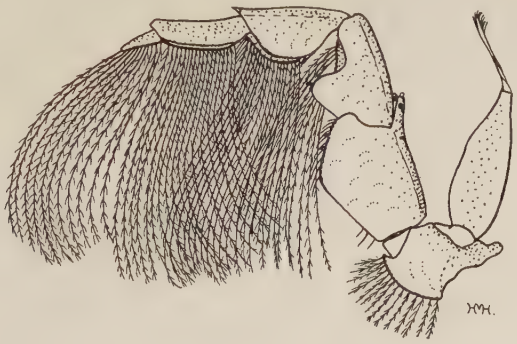


Fig. 77.—Third maxilliped of *Porcellana dispar* (x 15).

The manner in which the Porcellanids obtain their food is extremely interesting. The third maxillipeds are very long, and are densely fringed with long plumose hairs (fig. 77); these organs are thrown forward in the manner of a casting net to secure the tiny life which is eaten. In the illustrations of the species the feathery maxillipeds will be noticed, standing out from the front of the body. Our genera are separated as follows:—

a. Walking legs terminating in one claw.
  b. First joint of second antennae extremely short .. *Petrocheles.*
  bb. First joint of second antennae long, and joined to the margin of carapace .. .. *Porcellana.*
aa. Walking legs terminating in two claws .. .. *Polonyx.*

PETROCHELES (Miers).

Spiny Porcelain Crab. *Petrocheles australiensis* (Miers). (Australian).

This, the largest of our Porcelain Crabs, bears a rather strong resemblance to the members of the preceding family. The carapace is about as long as wide and, like the appendages, is covered with scale-like striae, fringed with short hairs. The front is produced into a prominent, flattened rostrum, which has three or four small spines on its lateral edges. There are only three distinct joints in the peduncle of the first antennae. The wrist of the

large chelipeds, and the walking legs, are armed with rows of spines. Length of carapace: 23 mm., or nearly 1in. (S.A.M.)

Fig. 78.—*Petrocheles australiensis* (nat. size).

PORCELLANA (Lamarck).

Little Porcelain Crab. *Porcellana dispar* (Stimpson). (different).

A small species which is moderately common on our coasts. The carapace is slightly longer than wide, and is marked with numerous small striae.

Fig. 79.—*Porcellana dispar* (x 3).

some of which bear soft, feathery hairs. In dorsal view the front is bilobed, the median portion being strongly bent downwards. Four distinct joints are apparent in the peduncle of the second antennae, the first being large, joined to the margin of the carapace, and forming the outer border of the orbit, or eye-socket. The inner margin of the wrist of the chelipeds is divided into three lobes, margined with minute teeth. Length of carapace: 6 mm., or $\frac{1}{4}$in. (S.A.M.)

POLYONYX (Stimpson).

Polished Porcelain Crab. *Polyonyx transversus* (Haswell). (transverse, *i.e.*, broader than long).

This creature is apparently very rare in South Australian waters, only one specimen having been captured therein. The species was first discovered in Queensland in the siphons of a bivalve mollusc. The carapace is convex,

Fig. 80.—*Polyonyx transversus* (x $2\frac{1}{2}$).

not flattened as in our other two species, and is relatively much wider, being nearly half as broad again as long; the surface is shining and almost smooth. As in *Porcellana,* the first joint of the second antennae is large and prominent. The walking legs each terminate in two small claws. The abdomen is large, and in the female reaches forward to the level of the eyes when folded against the body. Length of carapace: 8 mm., or $^{5}/_{6}$in. (S.A.M.)

Tribe **THALASSINIDEA.**

Two of the four families included in the tribe are represented. They comprise lobster-like, loosely-built crustaceans which burrow in sand or mud, or which live in cavities on reefs, or in sponges. The carapace is short, the eyes are small, and the abdomen is long, soft and extended.

a. Pleura (or side-flaps) of abdominal somites comparatively large . . . . . AXIIDAE.

aa. Pleura of abdominal somites small . . . . . CALLIANASSIDAE.

Family AXIIDAE.

AXIUS (Leach).

The legs of the first pair are subequal in size and bear moderately large pincers; the second legs terminate in small nippers, and the last three pairs are simple.

Slow Shrimp. *Axius plectorhynchus* (Strahl). (with a plaited rostrum).

The flattened rostrum terminates in two slightly upturned points, and its lateral margins are provided with similar teeth; usually five (including the apical spine) are present on each side, but in some cases four or six are present. Two varieties occur, and are occasionally taken in company; in

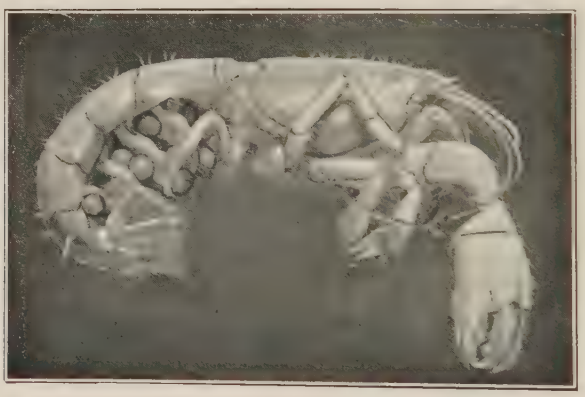


FIG. 81.—*Axius plectorhynchus* (nat. size).

one the adult ovigerous females do not exceed one inch in length, but in the other a much larger size is attained. As shown in the photograph, the eggs are relatively very large; the young do not pass through a metamorphosis, but hatch in the form of their parent, and cling to the swimmerets of the mother for some time. The Slow Shrimp lives amongst rotten limestone on reefs in St. Vincent and Spencer Gulfs, and has also been taken in soft mud at Kangaroo Island. The life colouration of a typical example of the large variety was as follows:—Cephalic portion of carapace slaty-blue, with

vivid red markings; dorsum of rest of thorax and of abdomen fleshy pink, the posterior margins of each pleon segment margined with yellow. Both pairs of antennae yellow. Large chelipeds marked with red on upper surface, the remaining legs and the swimmerets white. Length: 70 mm., or 2¾in. (S.A.M.)

Family CALLIANASSIDAE.

The family is divided into two subfamilies:—

a. Rostrum large ..... UPOGEBIINAE.

aa. Rostrum small ..... CALLIANASSINAE.

Subfamily Upogebiinae.

UPOGEBIA (Leach).

The second legs do not terminate in chelae.

a. First legs not chelate, the lower finger much shorter than the other ..... *simsoni.*

aa.. First legs chelate, the lower finger long ..... *bowerbankii.*

Sand-borer. *Upogebia simsoni* (Thomson). (personal name).

This species may be at once recognized by the subchelate legs and the shape of the carapace, which is produced anteriorly to form three prominent prongs, the median of which is the rostrum. Also, the eggs are very much smaller than in the Slow Shrimp. During life the creature is creamy-yellow, in parts delicately flushed with pink. It is common on the north coast of Kangaroo Island, in the Gulfs, and also occurs in Tasmania and Victoria. In places where it abounds, numbers may be obtained by poisoning small pools left by the tide, and apparently destitute of life. In one such pool a score of individuals appeared out of the sand in which they were buried, the last emerging forty minutes after the introduction of a small quantity of formalin. Length: 40 mm., or 1 $^{9}/_{16}$in. (S.A.M.)

Sponge Shrimp. *Upogebia bowerbankii* (Miers). (personal name).

The wide rostrum is bent slightly downwards, is clothed above with dense hairs, and its edges are furnished with five upstanding spines on each side. The lateral parts of the dorsum of the carapace in front of the cephalic groove are denticulate, and the lateral margins (behind the rostrum) are also armed with small upstanding spines. As in *Axius* there are apparently two varieties; the smaller is common in the interior of sponges dredged in St. Vincent Gulf; adult ovigerous females of this variety are only about

three-fourths of an inch in length. The ova are relatively very large. Length: 45mm., or 1 $^{13}/_{16}$in. (S.A.M.)

Fig. 82.— *Upogebia darwinii* (after Miers, x 3).

This species is referred to a subgenus (*Gebiopsis*) distinguished by the characters given in the above key; in a single (possibly abnormal) South Australian example, however, the lower finger of the hand is much smaller than the movable finger. An illustration of a closely allied species is here reproduced: *U. bowerbankii* is very like it in general appearance.

Subfamily Callianassinae.

As indicated, the members of this subfamily, unlike those of the Upogebiinae, have a tiny rostrum.

CALLIANASSA (Leach).

The exoskeleton is thin and weakly calcified excepting in the large pincer limbs; which are much compressed; the second legs terminate in small chelae. Two species have been taken.

a. One of the first pair of legs much longer than the other *ceramica.*
aa. Legs of first pair equal, or nearly equal, in size . . . . *aequimana.*

Large-clawed Burrower. *Callianassa ceramica* (Fulton and Grant). (wax-like).

The bigger cheliped may be on either the right or left side; the wrist and hand are very large and flat, convex on the outer surface and concave on the inner; the remainder of the limb appears ridiculously weak in comparison. Adult examples have the lower margin of the merus of the large cheliped keeled, and further produced, near the hinder end, into a lobe, which, like the keel, is serrated. The telson is large, with the hinder margin rounded. During life the animal is creamy-white, flushed with reddish. As the name implies, it lives in burrows in sand or mud, often penetrating to a depth of three feet or more; individuals have been dug out of their retreats at Marino. The species was first noticed in Victoria. Length 63 mm., or 2½in. (S.A.M.)

Ambidextrous Burrower. *Callianassa aequimana* (Baker). (equal handed).

This form differs from the other members of its genus in having the first legs of almost equal size. Also the tail-fan is unusually small; the telson is short, with the hinder margin incised. In the illustration the left hand and wrist are turned on edge, and the outer surface of the other chela is shown. The wrists and hands have sharp ridges on both upper and lower margins; the outer surfaces are convex and smooth, and the inner faces are concave. The merus is smooth, with a faint S-shaped ridge on the outer surface. Only three specimens are known; these were taken at Kingston, on the south-east coast. Length: 64 mm., or 2½in. (S.A.M.)

An American species of the genus forms deep, perpendicular burrows, with the sides compacted and the entrance projecting above the surface of the sand, like a little chimney. Callianassae and other crustaceans which may be missed by the dredge owing to their burrowing habits are sometimes taken in the stomachs of fishes; it is said that the British Mud-burrower forms a part of the food of the haddock.

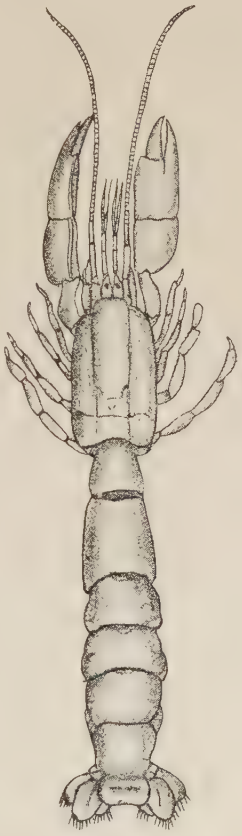


Fig. 83.—*Callianassa aequimana*, after Baker (nat. size).

Tribe **PAGURIDEA.**

Species of two families occur. The first family comprises the familiar Hermit-crabs, and the second is represented by a hairy, crab-like creature.

a. Abdomen extended, straight or spirally twisted. At least the sides of the hinder part of the carapace soft. Fourth legs unlike third pair. .. Paguridae (Hermit-crabs)

aa. Abdomen bent under thorax, as in the true crabs. Carapace hard all over. Fourth legs similar to third pair .. .. Lithodidae (Stone-crabs).

Family PAGURIDAE.

The marine Hermit-crabs have long attracted popular attention by their habit of protecting the soft abdomen with the discarded shell of a Gasteropod mollusc, or some other object. The abdomen is usually lop-sided and twisted to conform to the shape of the shells in which the creatures live. It has been noted that Hermit-crabs maintained in aquaria are very pugnacious, fighting whenever they chance to meet. When alarmed they withdraw into their shells or other retreats, and guard the entrance with one or both of the first pair of legs, which are developed as strong chelae; the second and third pairs of legs are used for walking—or, rather, for dragging themselves and their often heavy houses about. The modified tail-fan forms an anchoral apparatus which holds the crustaceans firmly in their houses, and the relatively small fourth and fifth legs are utilised to change the position of the body therein. As a Hermit-crab increases in size, successively larger shells are utilised for protection; these shells often have marine growths—barnacles, sponges, Bryozoa, and so on—attached to their surface.

Reproduction.—The male is often larger than the female, and sometimes has larger chelae. The sexual organs are situate in the abdomen; the genital openings of the male are on the coxae of the last legs, those of the female on the coxae of the third legs. The eggs are often tiny and numerous, in which case the young hatch as symmetrical Zoeae. Our Miner Hermit-crab apparently has a "direct" development, and in at least one other of our species—a small undescribed form living near shore at Kangaroo Island—the eggs are few in number, and are relatively very large; it is probable that the young of this species emerge from the ova at a more advanced stage. The eggs are carried on the abdominal appendages of the mother, and in some cases are protected by a thin flap, or brood-pouch, on the side of the abdomen. Five genera are represented.

a. A pair of appendages on the first abdominal segment of both sexes . . . . . *Paguristes.*

aa. Paired appendages never present on the first abdominal segment.

b. Tail-fan not symmetrical.

c. External maxillipeds approximated at base.

d. Fingers of chelae opening and closing horizontally . . . . . *Clibanarius.*

dd. Fingers of chalae opening and closing obliquely or nearly vertically . . . . . *Dardanus.*

cc. External maxillipeds distinctly separated at base. *Pagurus.*

bb. Tail-fan symmetrical . . . . . *Cancellus*

PAGURISTES (Dana).

The chelipeds are subequal in size, or one is much the larger. The telson is lop-sided and twisted to the left in both sexes. Each of the first two abdominal segments of the male has a pair of unbranched pleopods, which are modified as sexual organs, and the female has a pair of appendages on the first pleon segment. She also has a membranaceous lobe, which arises from the fourth abdominal segment and forms a pouch for the ova.

a. Left chela much larger than right.

b. Hands and fingers with small granules . . . . . *frontalis.*

bb. Hands and fingers with large compound tubercles . . *tuberculatus.*

aa. Chelae of equal, or almost equal, size.

c. With distinct rostrum. Hands hirsute, the hairs almost concealing the tubercles beneath . . . . . *sulcatus.*

cc. With no distinct rostrum. Hands slightly hirsute, the hair not concealing the tubercles beneath . . *brevirostris.*

Common Hermit-Crab. *Paguristes frontalis* (M. Edwards). (with a forehead).

This Hermit-crab is taken near shore or in shallow water on all our coasts, and is our commonest representative of the family; its predominating colour is red. The hand of the left cheliped is large and plump, and has a granular surface; it is pale yellow, or whitish (sometimes faintly tinged

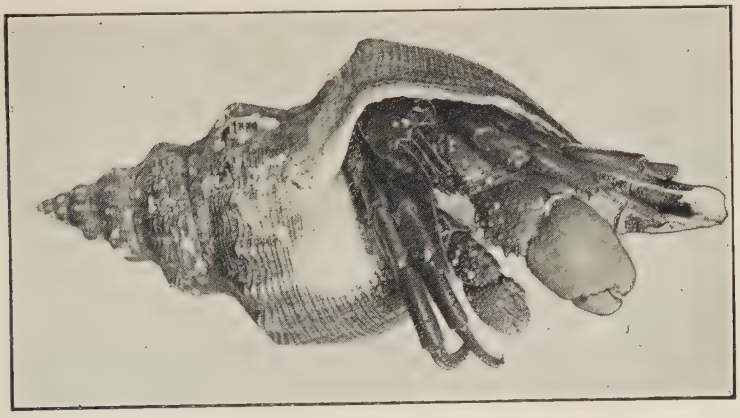


Fig. 84.—*Paguristes frontalis* in *Fusus* shell (½ nat. size).

with red basally), and offers a striking contrast to the other legs, which are red. The right wrist and hand, and the wrist of the left side, are armed with tubercles, some of which are spine-like. The rostrum is small and triangular, and is bent down between the bases of the scales of the eye-stalks. The egg-pouch of the female is large. Length: 80 mm., or 3⅛in. (S.A.M.)

old bones; for the space of a few seconds they then produced a loud stridulating sound; when recovered from their alarm they would recommence

Fig. 87.—*Clibanarius strigimanus*, with left cheliped detached to show stridulatory areas (½ nat. size).

their peregrinations." The creature is occasionally taken in our seas, and the file-like stridulating ridges enable it to be readily identified. Length: 128 mm., or 5in. (S.A.M.)

DARDANUS (Paulson).

The abdomen is coiled as in the two preceding genera, but *Dardanus* differs from those in that the fingers open in a vertical direction. The chelipeds are usually dissimilar, the left chela being much the larger. Our two forms are readily separated.

a. Legs very hairy, armed with spines, but no striae. Eye-stalks long, red .. .. *megistos.*

aa. Legs with sparse hairs, armed with spines and numerous striae. Eye-stalks shorter, with two red bands .. .. *arrosor.*

Spotted Hermit-crab. *Dardanus megistos* (Herbst). (very large).

A large species which is common in Indian seas, but is apparently very rare off southern Australia. The predominating colour is red; the carapace and legs are marked with numerous white spots, edged with blackish. The last three joints of the chelipeds and walking legs are thickly clothed with tufts of bristle-like hairs. The creature somewhat resembles the Stridulating Hermit-crab in general appearance, but the left hand is much larger than the right, and there are no file-like areas on the inner surface. Length: 140 mm., or 5½in. (S.A.M.)

Fig. 88.—*Dardanus megistos* (after Alcock, $\frac{1}{3}$ nat. size).

Striated Hermit-crab. *Dardanus arrosor* (Herbst). (one who gnaws). This, like the foregoing, is one of the largest of Hermit-crabs. The left hand is much larger than the right; the chelipeds and walking legs are

Fig. 89.—*Dardanus arrosor* ($\frac{1}{2}$ nat. size).

not densely clothed with tufts of long bristles, but are marked with numerous transverse striae, which are fringed with very short hairs. Length: 140 mm., or 5½in. (S.A.M.)

PAGURUS (Fabricius).

Differs from the preceding genus in having the maxillipeds widely separated at the base. The chelipeds are usually unequal, the right being the larger; the fingers open and close horizontally.

Dwarf Hermit-crab. *Pagurus nana* (Henderson). (a dwarf).

The hands are relatively large, and the right chela is much more developed than the left. The accompanying illustration shows other essen-

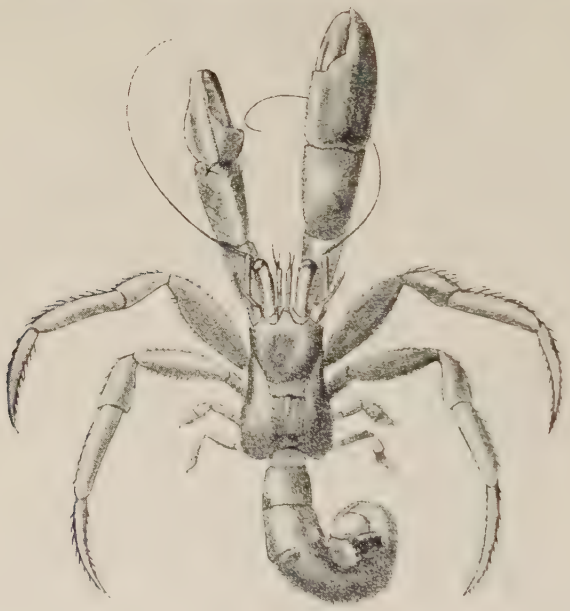


Fig. 90.—*Pagurus nana* (after Henderson, x 3).

tial differences between this and our other Hermit-crabs. The species is rare in South Australian waters. Length: 20 mm., or about ¾in. (S.A.M.)

CANCELLUS (M. Edwards).

In this genus the abdomen is soft, but is simply flexed and symmetrical, not lopsided as in our other genera; further the chelipeds and the next pair of legs are modified to form a stopper to the hole in which the creature lives.

Miner Hermit-crab. *Cancellus typus* (M. Edwards). (a type or pattern).

This interesting Hermit-crab was first described about ninety years ago, without definite locality, and half a century later was re-discovered in St.

Vincent Gulf, South Australia, and Port Jackson, New South Wales: it also occurs in Victoria. The animal does not ensconce itself in a shell, but

Fig. 91.—*Cancellus typus* (nat. size).

lives in tunnels (which it is said to excavate for itself) in fragments of soft stone. The front of the first and second pairs of legs is flattened and thickened, and these legs fold together in such a way that the mouth of the tunnel is closed; when withdrawn into its retreat the creature is thus

Fig. 92.—*Cancellus typus* ensconced in a fragment of rock; note how the legs form a perfect "stopper" to the mouth of the retreat (nat. size).

perfectly protected from marauders, the only exposed part being a hard and flat discoidal area (fig. 92). A female dredged in St. Vincent Gulf had a brood of thirty young clinging to the abdominal appendages; these

juveniles are about 4 mm. in length and have the form of the adult, showing that they hatch at a very advanced stage of development. Length: 38 mm., or 1½in. (S.A.M.)

Family LITHODIDAE.

As mentioned above, the Lithodids are crab-like in form. They were, indeed, at one time placed in the tribe Brachyura, but may be separated at a glance by the fact that the last pair of thoracic limbs is hidden; thus only four pairs of legs are visible, instead of five as in our true crabs.

LOMIS (M. Edwards).

Hairy Stone-crab. *Lomis hirta* (M. Edwards). (shaggy or hairy).

The carapace is as wide as its medial length, and the upper surface of body and legs is clothed with short bristles, arranged in groups; the carapace and dorsum of the wrists and hands are furnished with bead-like granules, which are rendered inconspicuous by the hairs clothing the inter-

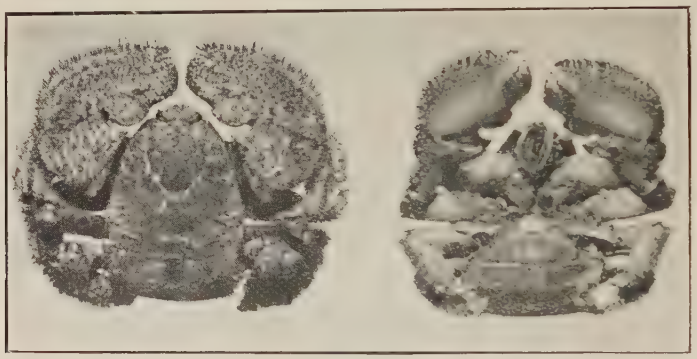


Fig. 93.—*Lomis hirta*, dorsal and ventral views (x 1½).

spaces. During life the colour is dingy brown above; the abdomen and the naked under surface of the legs are blue, or white tinged with blue. The antennae and palp of the outer maxillipeds are vivid blue. Length of carapace: 16 mm., or ⅝in. (S.A.M.)

This little crab occurs in Tasmania, but is also taken in both South Australian Gulfs, on the shores of the Great Australian Bight, and on our south and south-eastern reefs. It is common on some reefs in St. Vincent Gulf, where numbers may be taken by turning over loose stones at low tide; the slow-moving crabs are found clinging to the underside of these rocks.

Tribe **HIPPIDEA.**

The carapace is elongate, usually more or less ovate in shape. The second to fourth legs have the last joint curved and flattened for shovelling; the abdomen is bent under the body, and the telson is elongate, far exceeding the rest of the pleon in length.

Family HIPPIDAE.

HIPPA (Fabricius).

The genus comprises small creatures, obscurely crab-like in form, which burrow in sand or mud. They inhabit warm seas, and only a single imperfect specimen has been taken in South Australian waters.

Southern Mole-crab. *Hippa australe* (sp. nov.). (southern).

The carapace is oval, with the front obscurely trilobed, the broad median angle being extremely obtuse; the anterior margin is finely crenulate, and the dorsal surface is marked with numerous crenulate impressed lines from

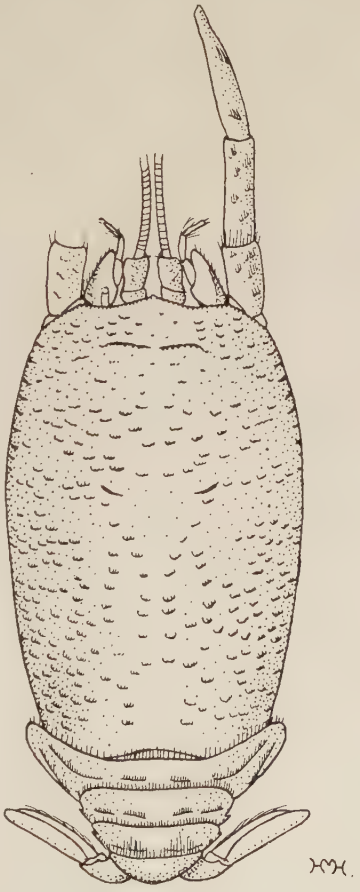


FIG. 94.—*Hippa australe* (x 4).

which emanate short, adpressed bristles. The outer part of the second joint of the second antennae is produced forwards to beyond the apex of the third joint. The first legs are long and rather slender, about as long as the carapace. The telson of the abdomen is lanceolate with two very divergent short grooves at the base. Length of carapace: 11.5 mm., or $^{7}/_{16}$in. (S.A.M.)

The species is represented in the collection by a cast exoskeleton picked up on the beach at Corney Point, at the mouth of Spencer Gulf.

Chapter VI.—Order DECAPODA (contd.). The True Crabs.

Suborder REPTANTIA

(contd.).

Section BRACHYURA.

The last, and aptly named Section of the Reptantia (*brachys,* short; *oura,* a tail) includes all the true crabs; in these the abdomen is reduced to a mere flap, and is folded under and against the body. Before defining the group further, the terminology of the parts commonly used in descriptions is given for reference purposes. Our common Rock-crab (*Nectocarcinus integrifrons*) is taken as an example of the Section. A comparison of the external anatomy of this crab with that of the Murray Lobster described in Chapter ii. will show that the structural plan is the same in both species.

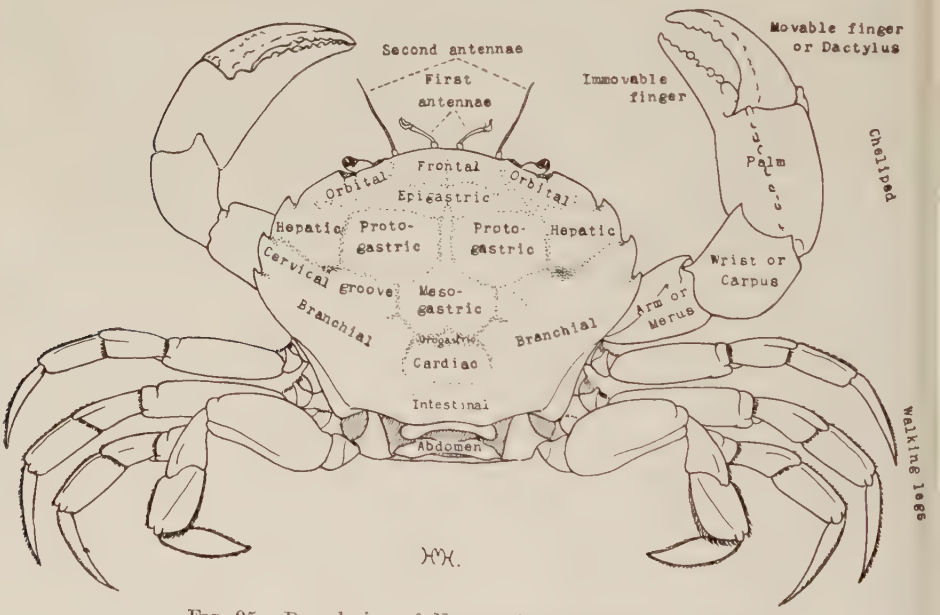


Fig. 95.—Dorsal view of *Nectocarcinus integrifrons* (½ nat. size).

If a crab be viewed from above, the carapace, apart from the five pairs of legs, is the most apparent area of the creature; if a few species are examined it will be noted that they exhibit obvious differences in the shape, contour, and sculpture of the "shell." It is not remarkable, therefore, that the character of the carapace is of considerable classificatory value. The upper surface is more or less distinctly marked off into "regions," and these are well defined in the Rock-crab (fig. 95). A large median area overlying the stomach is called the gastric region, and is subdivided into several

subregions or lobes named the mesogastric (middle gastric lobe), protogastric (antero-lateral gastric lobes), epigastric (anterior gastric lobes), and urogastric (genital region or postero-median gastric lobe). On each side of the gastric region as a whole is an hepatic region, covering the liver, while a small area around each eye socket is an orbital region. Between these last and in front of the gastric, is a frontal region. The cervical groove separates the aforementioned regions from four others, the branchial regions overlying the gills and the cardiac and intestinal regions roofing respectively the heart and the intestine. On the underside of the carapace (fig. 96) a large space on each side of the mouth frame (or buccal frame) is termed the pterygostomian region (sometimes also called the jugal region), a narrow space bordering the lower edge of the orbit is known as the suborbital region

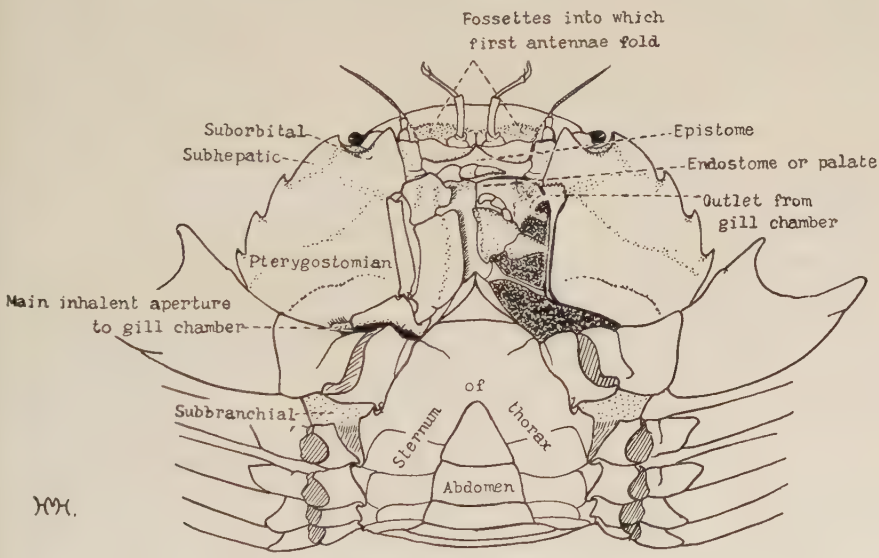


Fig. 96.—Ventral view of *Nectocarcinus integrifrons* (⅔ nat. size).

and a small area below the hepatic as the subhepatic region. The subbranchial regions form the undersides of the gill-chambers. On each side of the front is a cavity, or orbit, in which the stalked eyes are ensconced; the short first antennae, when folded, lie in special hollows termed fossettes. The mouth frame is large and square, and is closed by the outer, or third, pair of maxillipeds, which have all but the three terminal joints— the palp —expanded and flattened; in the illustration of the underside, the maxillipeds and maxillae of the left side of the crab have been removed, and the mandible thus exposed. The roof of the mouth cavity is the endostome or palate, sometimes spoken of as the prelabial space; in front of the buccal cavity is a wide plate, the epistome.

The mouth-parts of the left side of the Rock-crab are illustrated in fig. 97; as in most crabs the epipods of the three pairs of maxillipeds are in the form of long, curved blades, the function of which is described later.

All true crabs are distinguished as follows: —The carapace is large, covering the whole of the head and usually the whole of the thorax also; it is fused with the epistome at the sides, and a short process from the front extends down to the epistome, forming a little bar between the first antennae, the basal segment of which contains "auditory" hairs but no otoliths. The third pair of maxillipeds are flattened, as a rule broadened, and form a pair of covers for the well-defined mouth cavity and for the remaining mouth parts lying in that cavity. The first pair of legs are chelate, terminating in perfect and often relatively large "pincers"; the following four pairs are usually

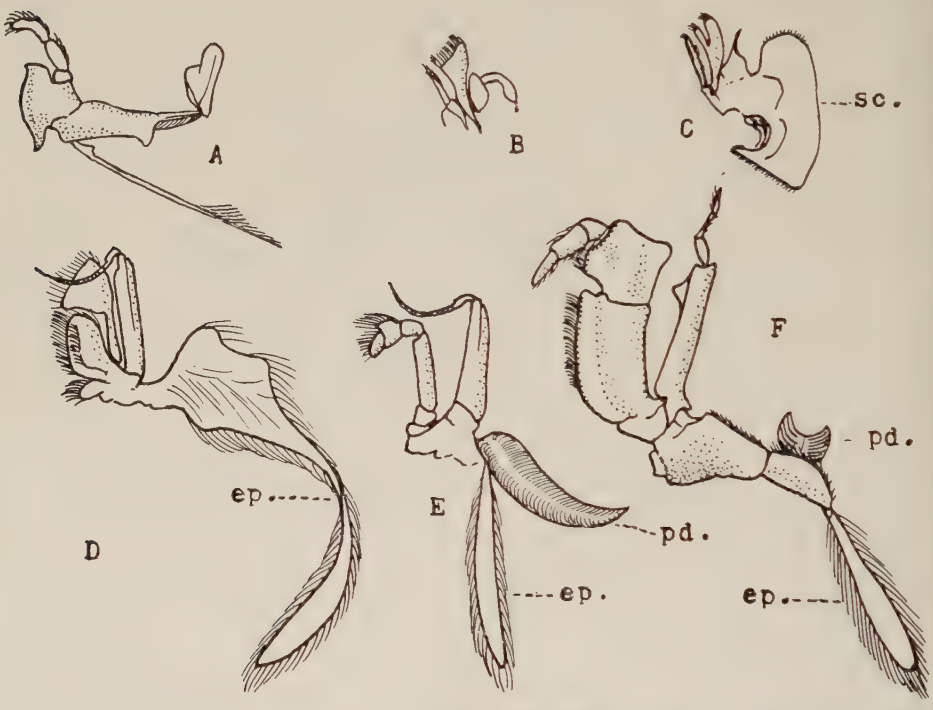


FIG. 97.—Mouth appendages of *Nectocarcinus integrifrons*; A, mandible; B and C, first and second maxillae; D, E and F, first, second and third maxillipeds. sc., Scaphognathite; ep., epipod; pd., podobranch (nat. size).

modified for walking or swimming, but may be prehensile. The last of the sternal segments is fused with the rest, and the small, symmetrical abdomen has no tail-fan, and shows no indication of any function other than reproduction.

Respiration.—The lower margins of the branchiostegites, or side-flaps of the carapace, are not separated from the thorax as in the long-tailed Decapods, but fit snugly to the bases of the legs, the main aperture for indrawn water being situated, in most crabs, at the front of the basal joint of the chelipeds. One of the principal pair of inhalent slits of the Rock-crab are indicated in fig. 96; the front of the basal joint of the cheliped, forming the hinder limit of the slit, is equipped with a fringe of hairs, as

is also that part of the edge of the carapace constituting the opposite, or anterior, edge of the respiratory aperture. These fine hairs serve as filters, and to some extent prevent foreign material from entering the gill-chamber. A process from the outer maxilliped forms a valve with which the inhalent opening may be varied in size or, in conjunction with the coxa of the cheliped, closed; this mechanism is the modified base of the epipod of the third maxilliped. While the apertures at the base of the chelipeds are the main openings through which a current flows into the gill chamber, it is probable that water, to a lesser extent, is also drawn in between the bases of the walking legs and the edge of the carapace, which is furnished with a fringe of short hairs. If the three pairs of maxillipeds are removed, or pushed to one side, the openings through which the water escapes from the gill-chambers are exposed (fig. 96); these orifices are found one on each side, and towards the front, of the mouth frame, and in each opening lies the maxillary fan, or scaphognathite (fig. 97 C, sc.) which scoops water along the exhalent passage out of the gill-cavity. It has been shown that the long, curved epipods of the three pairs of maxillipeds of crabs are modified to form an important duty; they are equipped with flexible hairs, and are used to keep the delicate gills swept free of fine particles of matter which would otherwise clog the organs (fig. 97 D, E, and F., ep.). Investigators have demonstrated that at intervals the respiratory current of a crab may be reversed, water being taken in at the anterior corners of the mouth frame and expelled at the base of the chelipeds; in fouled water the temporary reversal of the current probably materially assists the work of the epipods of the maxillipeds in removing fine debris accumulated on the gills.

Further modifications of this system are found in crabs which habitually lie buried in mud or sand (Oxystomata and Euryalidae); in the Frog-crabs (Raninidae), no species of which is known to occur in South Australia, water apparently enters the gill-chamber between the edge of the carapace and the bases of the *last* pair of legs.

The gill system of a long-tailed Decapod has already been described; if the carapace of our Rock-crab be carefully levered off, the gills packed in the branchial chambers are exposed: there are nine of these organs on each side. The third maxilliped has a small gill, or podobranch, on the coxa (fig. 97 F, pd.) and two larger branchiae on the membrane connecting the coxa to the body wall (arthrobranchiae). There is one podobranch (fig. 97 E, pd.) and one arthrobranch on the second maxilliped, two arthobranchs on the cheliped, and a gill on the body-wall above each of the first two walking legs (pleurobranchiae).

Reproduction and Development.—As mentioned above, the pleopods on the underside of the flap-like abdomen are, in both sexes, specialized solely for reproductive purposes. The male has only the first two pairs, which are styliform, and operate as copulatory organs (fig. 98 A and B); of the remaining pleopods there is no trace, but some of the sponge-crabs have mere

vestiges of the uropods. In this sex there is always a pair of penes, with the ends lying inside the first pair of intromittent organs, each of which is "rolled like a scroll," and thus forms a hollow tube; the copulatory appendages of the second pair are styliform, and either lie closely against the first pair or are inserted in the channel occupied by the tips of the penes. The vasa deferentia emptying into the penes perforate either the wall of the basal joint of the last pair of legs or its articular membrane (as in most other Decapods) or else do not enter the coxae at all, but open on the sternal surface, near the bases of the last legs.

The abdomen of the female is relatively wider than that of the male, and, excepting in a very few instances, the second to fifth pairs of pleopods are modified to carry the eggs. The base of these appendages is short, but the two branches of each are long, slender, or flattened, and are usually fringed with hair; the first pair is absent in all excepting the Sponge-crabs. One of the abdominal appendages of a female Rock-crab is shown in fig. 98 C.

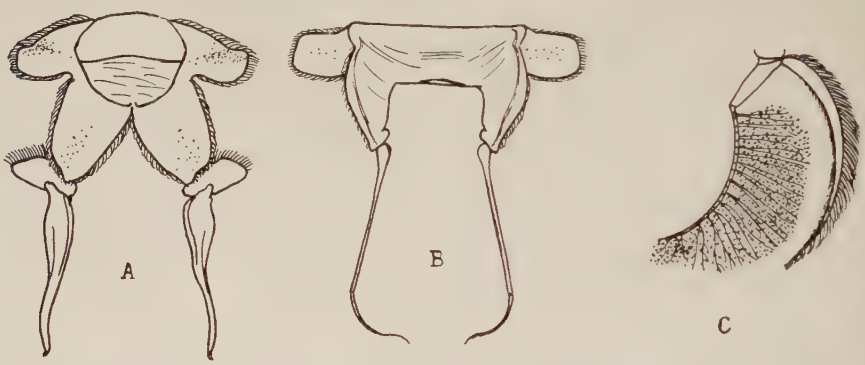


FIG. 98.—A and B, First and second male abdominal segments and appendages of *Nectocarcinus integrifrons*; C, pleopod of third segment of female, with eggs attached to endopod (nat. size).

The slender inner branch carries a mass of eggs attached to long fringing hairs, but the hairs of the broader outer ramus are of different character and bear no ova; these branches of the pleopods together form the lateral portions of an egg-chamber closed in below by the abdomen and above by the vaulted sternum. In some crabs as, for instance, in certain of the Oxystomata, the strongly convex abdomen fits against the sternum, and the ova are thus entirely enclosed; the exopods of the pleopods are in this case thin and feeble. In most of the Brachyura, and excepting where otherwise mentioned, the oviducal openings are found on the surface of the antepenultimate sternal segment, instead of on the coxae of the legs of that somite. The terminal part of each oviduct is long, and serves as a vagina to receive the intromittent organs of the male; a lateral pouch of the oviduct forms a receptaculum for the male sperm.

The sexes are always easy to distinguish; dimorphism is often exhibited in the chelipeds, these being, in such case, stronger in the male. Apart from

all other characters, however, the narrow abdomen, with but two pairs of appendages, enables one to readily separate the male from the female, which has a wider abdomen, almost always equipped with at least four pairs of long appendages. Females of many species commonly bear an egg-mass so large that only portion of it is covered by the abdomen and outer rami of the pleopods, but, as already mentioned, in others the eggs may be entirely concealed.

Crabs do not hatch from the egg as a free-swimming *Nauplius,* but emerge at a later stage of development. In most of the marine species at least the *Nauplius* stage is passed in the egg; there is reason to believe that most of them hatch as a *Zoea*, and pass through this and another pelagic stage (*Megalopa*) before attaining the adult form. The fresh-water crabs, and a few marine species, have a "direct" development, and emerge from the egg as perfect little crabs which resemble the parent form. Fig. 99 shows the metamorphosis of the European Shore-crab (*Carcinides maenas*) a

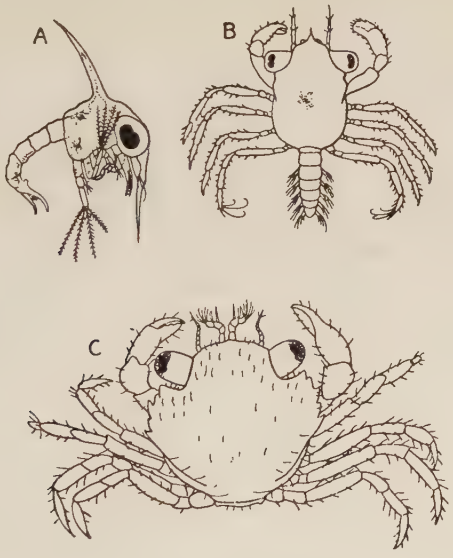


Fig. 99.—Larval stages of European Shore-crab (*Carcinides maenas*). A, *Zoea* (x 20); B, *Megalopa* (x 10); C, young crab (x 10) (after Williamson and Calman).

species introduced into Victorian waters years ago. Very soon after hatching, the young crab becomes a *Zoea;* this spiny larva has no abdominal appendages, and the fourth to eighth thoracic limbs are wanting. It swims at the surface, and feeds upon minute floating organisms. During this stage it repeatedly moults, increasing a little in size, and showing some slight developmental changes, after each ecdysis. After a time the *Zoea* abruptly enters the second, or *Megalopa,* stage, in which form it seems a very different animal. All the appendages are now present, indeed, the *Megalopa* has somewhat the appearance of the adult, excepting that the

abdomen is not tucked under the body. For a while it stays at the surface, but later sinks to the bottom, moults again, and emerges as a perfect little Shore-crab. The Zoeae of some crabs have remarkably produced spines on the carapace.

KEY TO TRIBES.

a. Mouth-frame more or less quadrilateral in shape.
  b. Last pairs of legs usually carried over the back. Female with openings on coxae, and with appendages on first abdominal somite . . . . . DROMIACEA.
  bb. Last pair of legs normal, not carried over the back in South Australian species. Female with openings on sternum and without appendages on first abdominal somite . . . . . BRACHYGNATHA.
aa. Mouth-frame narrowed in front, subtriangular in shape. OXYSTOMATA.

The characters separating these tribes are more fully explained and illustrated in place.

Tribe **DROMIACEA.**

The crabs comprising this tribe are regarded as the most primitive members of the section; it is held that they are descended from lobster-like ancestors and that they represent the origin of all other crabs. The Dromiacea are grouped into two subtribes, only one species of the second of these being so far recorded from our State:—

a. Eyes sheltered by orbits. Sternum of female longitudinally grooved . . . . . DROMIIDEA.
aa. Eyes not or incompletely sheltered by orbits. Sternum of female not grooved . . . . . HOMOLIDEA.

Subtribe **DROMIIDEA** (Sponge-crabs).

Family DROMIIDAE.

The sponge crabs have long excited interest on account of their habit of carrying some marine object more or less constantly on the back. In our species the burden is usually a mass of sponge, or of simple or compound Ascidians. The two hinder pairs of legs are modified to hold in position this living cloak, each being short, furnished with little pincers, and in almost all cases folded on to the back. Thus, under the mask of some other animal a Sponge-crab is concealed and otherwise protected from enemies; doubtless the sponge or Ascidian also derives some benefit by being carried about, so that the habit represents a symbiotic relationship of two forms of animal life. Dr. Haacke, one-time Director of the South Australian Museum, suggested that the larvae of Ascidians are transmitted from the living cloak of the mother crab to the young.

Vestiges of uropods are often present in the sponge-crabs, but such indications are never found in the following family, nor in any other crabs.

Reproduction and Development.—The female has, in addition to the long modified pleopods on the second to fourth segments of the abdomen, a shorter pair on the first segment, a condition not found in either of the other two tribes; the lateral pouches of the oviducts (the receptacula seminis) are apparently formed temporarily in the sponge crabs, appearing only at the mating period. The oviducts perforate the coxae of the last pair of legs. If the abdomen of a female Dromiid be lifted, it will be noticed that the sternum beneath is traversed by a pair of longitudinal grooves, which may end in tubercles. These special grooves, as indicated by the key above, are typical of the Sponge-crabs; they may be widely separated, or may almost touch anteriorly, and constitute a feature which is of considerable value in recognising the genera.

In at least two of our species there are no free-swimming larval stages but the young hatch at an advanced state of development, and for a time shelter beneath the pleon of their parent before commencing an independent life. The eggs of at least two other of our forms are relatively very large, indicating that probably here, also, the metamorphosis is suppressed; Decapods which have a "direct" development (such as the fresh-water crayfishes, fresh-water crabs, etc.) produce larger eggs than those which pass through a series of pelagic larval stages.

a. Chelipeds without an epipod.
  b. Sternal grooves of female ending close together anteriorly.
    c. Carapace much flattened .. .. *Platydromia.*
    cc. Carapace convex .. .. *Dromidia.*
  bb. Sternal grooves of female widely separated anteriorly .. .. *Cryptodromia.*
aa. Chelipeds with an epipod.
  d. Sternal grooves of female ending close together anteriorly .. .. *Dromidiopsis.*
  dd. Sternal grooves of female separated anteriorly.
    e. Walking legs without knobs or ridges .. .. *Dromia.*
    ee. Walking legs with knobs or ridges .. .. .. *Petalomera.*

PLATYDROMIA (Fulton & Grant).

Flat Sponge-crab. *Platydromia thomsoni* (Fulton & Grant). (personal name).

A small species, which differs from our other Sponge-crabs in having the carapace much flattened; it is as wide as long, subpentagonal in shape and clothed with short, stiff hairs. The front is divided into two large teeth; above and behind the front is a prominent, slightly-curved ledge, which is divided into four equal parts by deep grooves. This ledge lends the carapace, when viewed from above, a square-cut appearance. The chelipeds are shorter than the following pair of limbs; the legs, excepting for the tips of the fingers, are covered with dense hairy clothing. The last two pairs

do not lie over the back, but are turned up over the two preceding pairs. The ova are relatively large, being more than 1 mm. in diameter. Length of carapace: 13 mm., or ½in. (S.A.M.)

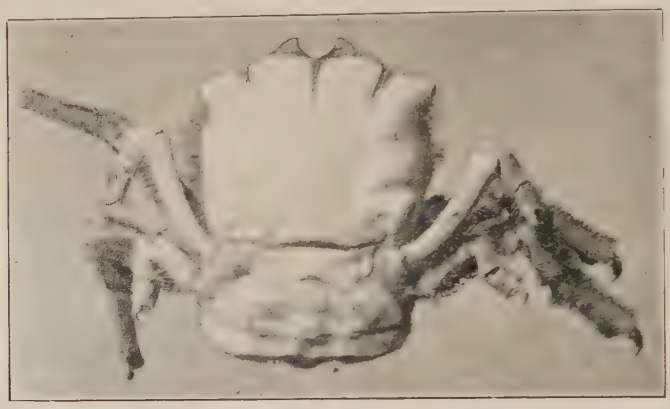


Fig. 100.—*Platydromia thomsoni* (x 2⅛).

DROMIDIA (Stimpson).

Two species occur:—

a. Antero-lateral margins of carapace each with four teeth .. .. *australis.*

aa. Antero-lateral margins of carapace entire .. .. *insignis.*

Southern Sponge-crab. *Dromidia australis* (Rathbun). (southern).

The front is cut into three teeth, and the antero-lateral margins of the

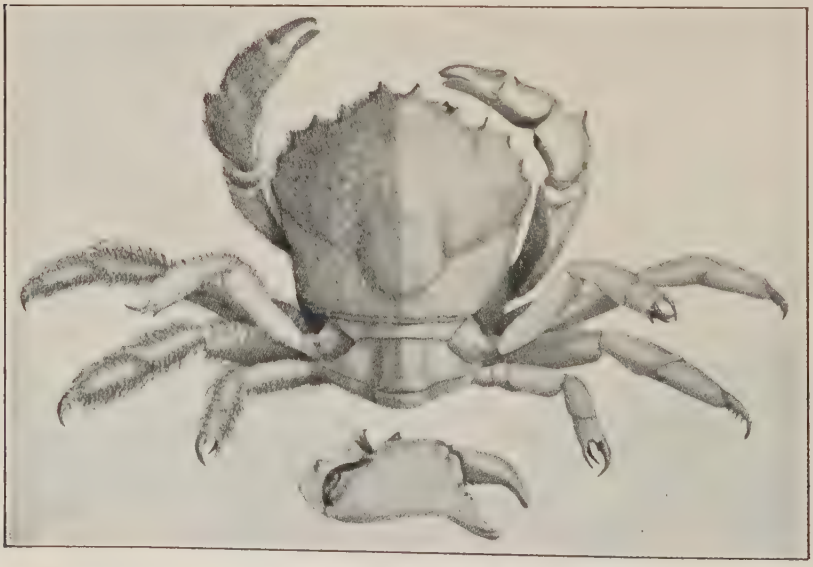


Fig. 101.—*Dromidia australis* (after Rathbun, slightly reduced).

carapace are each armed with four teeth. In the female, which is illustrated, the carapace is about as wide as long, but in the male it is relatively a little wider. The body is covered with very short hairs, and the carapace, legs, and abdomen are fringed with longer hairs. The eggs are very large, being 2 mm. in diameter. Length of carapace: 40 mm., or $1\,^{9}/_{16}$in. (S.A.M.)

Adorned Sponge-crab. *Dromidia insignis* (Rathbun). (adorned or distinguished).

The front is cut into three teeth, the median of which is scarcely visible in dorsal view; each antero-lateral margin is obtusely angular at about the middle of its length, but is not cut into teeth. The body and legs, excepting the fingers, are covered with harsh, spathulate hairs—a distinctive char-

Fig. 102.—*Dromidia insignis* (x 2).

acter; on the carpus and propodus of the legs these setae are massed to simulate ridges, and form a triangle on the outer surface of the fingers of the large chelae. This species is known only from a female taken off Victoria, and a single male, here illustrated, dredged off South Australia. Length of carapace: 17.5 mm., or $^{11}/_{16}$in. (S.A.M.).

CRYPTODROMIA (Stimpson).

Bristled Sponge-crab. *Cryptodromia octodentata* (Haswell). (with eight teeth).

The carapace is a little wider than long in large examples. The body and legs are covered with erect bristles, which have a brush of tiny spikelets on the distal part; the clothing is sometimes more or less abraded in old examples. There are four, sometimes five, teeth on each of the antero-lateral margins of the carapace; the front is cut into three teeth, the rostral tooth being on a lower plane than the others. There are no knobs or ridges on the legs, and there is a spine on the outer side of the thorn-like dactylus of the last pair of legs. Length of carapace: 70 mm., or $2\frac{3}{4}$in. (S.A.M.)

This species, *Petalomera lateralis* and *Dromidiopsis excavata* are our commonest Sponge-crabs. Although the Bristled Sponge-crab attains to the size given above, such large examples are comparatively rare. The cloak

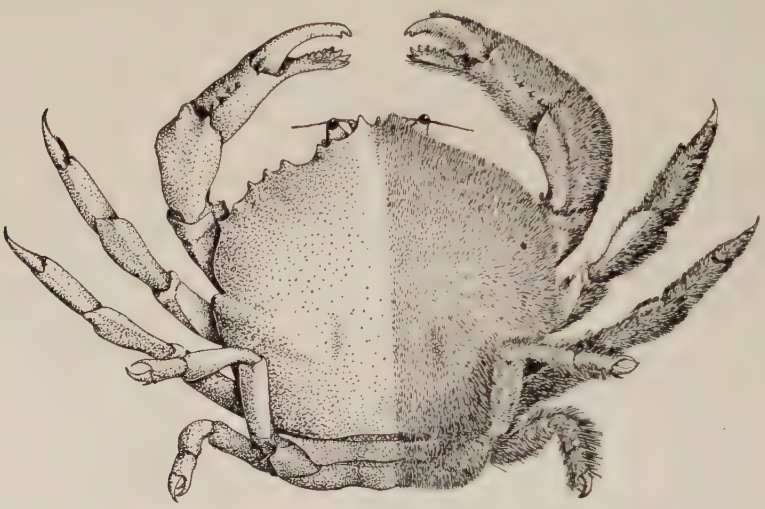


Fig. 103.—*Cryptodromia octodentata* (after Rathbun, about nat. size).

Fig. 104.—Female *Cryptodromia octodentata* with young (nat. size).

usually consists of a sponge or, more rarely, a mass of Ascidians, but sometimes other objects—a fragment of weed or a large shell—are utilised as masks; occasionally examples carrying no cloak are met with. Old

examples, for instance, may have marine growths attached to, and growing on, the carapace; on the coasts of Kangaroo Island young specimens three-fourths of an inch or so in width, and bearing no mask, were found living in between large masses of Ascidians in shallow water.

Reproduction and Development.—The large eggs are attached to long hairs emanating from the inner branches of the pleopods of the female. It is evident that the Bristled Sponge-crab does not pass through free-swimming larval stages, for an adult female collected in St. Vincent Gulf carried five hundred and thirty well developed young crabs beneath the abdomen (fig. 104). The juveniles have the general form of the adult, but differ considerably in certain characters (fig. 105); the carapace is longer than wide, the clothing and armature are different, the antennal flagella consist of

Fig. 105.—Brood young of *Cryptodromia octodentata* (x 12).

fewer joints, etc. A point of interest is that the young possess temporary natatory pleopods, although their habit at this stage is apparently quite sedentary. At each moult the carapace becomes wider in relation to its length, and by the time the animal has attained a length of about 15 mm., it is as wide as long.

The abdomen of the adult female, with the aid of the outer branches of the large pleopods, forms a pouch for the retention of the eggs, and, later, for the young crabs. In large examples the abdomen is half as wide as the carapace, and when closely adpressed its tip overlaps the basal fourth of the outer maxillipeds; thus, when the tip is placed in its normal position between the anterior edges of the coxae of the large pincer-limbs, the greater part of the apron stands away 10 mm. or so from the body. As the female carries a great number of large eggs, the abdomen of an ovigerous female is often forced far out of its usual position, but the contents of the apron are prevented from falling out by the large, flattened exopods of the second to fifth pleopods; the outer branches of these appendages

are densely fringed with outstanding hairs, and are so shaped that, when pushed outwards by the eggs or young, they overlap and form perfect side walls to the brood pouch.

DROMIDIOPSIS (Borradaile).

Shaggy Sponge-crab. *Dromidiopsis excavata* (Stimpson). (hollowed). A dense, transverse fringe of hairs, mounted on a low ridge across the front portion of the carapace, gives this crab a characteristic appearance. The carapace is a little wider than long. Its front is cut into three teeth, and the antero-lateral margins are not dentate. The margins of the legs

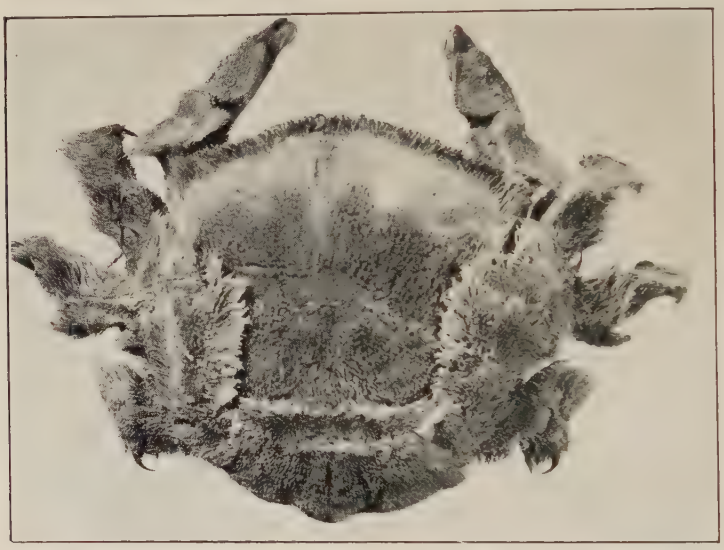


Fig. 106.—*Dromidiopsis excavata* (nat. size).

and of the abdominal segments are fringed with long bristles, and the remainder of the surface of the body and legs (with the exception of the finger-tips) is clothed with shorter hairs: during life the clothing is pink. Length of carapace: 41 mm., or 1⅝in. (S.A.M.)

DROMIA (Fabricius).

Eared Sponge-crab. *Dromia bicavernosa* (Zietz). (with two cavities). This species is remarkable in that there is a pair of large, kidney-shaped, ear-like cavities in the front of the carapace; this feature enables one to identify the creature with ease. The carapace is considerably broader than long. The whole of the external surface, with the exception of the frontal cavities and the finger-tips, is covered with a dense clothing of chocolate-brown hairs. The margins of the two cavities are red, and the finger-tips are white. Length of carapace: 60 mm., or 2⅜in. (S.A.M.)

The Eared Sponge-crab has been taken on the shores of Kangaroo Island, in Encounter Bay on the south coast, and in St. Vincent Gulf; only males

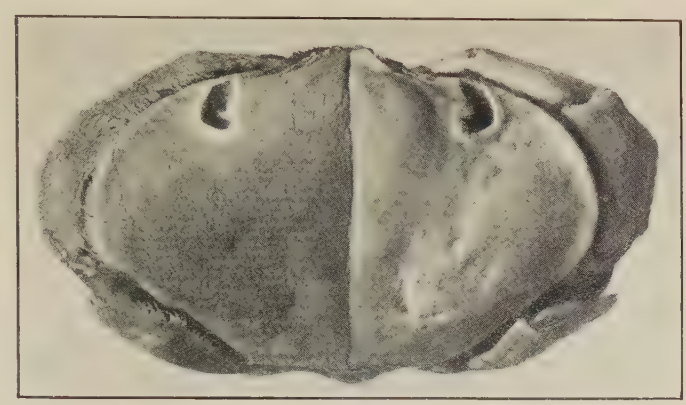


Fig. 107.—*Dromia bicavernosa* (slightly reduced).

have been secured. The specimen illustrated is tilted upwards to show the frontal cavities; the fur is removed from the right half of the carapace.

PETALOMERA (Stimpson).

The three following species occur in South Australia:—

a. Front with three teeth, the two outer of which are subacute. Regions not well defined.
  b. Walking legs with ridges . . . . . *lateralis.*
  bb. Walking legs with knobs . . . . . *depressa.*
aa. Front with three teeth, the two outer of which are obtuse. Clothing forming depressions and ridges, which define the regions clearly . . . . . *wilsoni.*

Ridged Sponge-crab. *Petalomera lateralis* (Gray). (relating to the side). The carapace of the adult is slightly wider than long. There are three subacute teeth on the antero-lateral margins (including one behind the cervical groove), a feeble tooth over each eye, and a small acute tubercle on the subhepatic region. These teeth are subject to some variation, and may be bifid or provided with small subsidiary tubercles. The sternal grooves of the female reach forward to the level of the coxae of the second pair of legs (the first ambulatory legs). The carapace is brown or yellowish during life, and usually has four slaty-blue markings on the posterior part. There is also a more or less distinct bluish marking on each side of the first two or three pleon segments. The legs are marked with blue, and the fingers of the large chelae are orange with white tips. Length of carapace: 20 mm., or $^{13}/_{16}$in. (S.A.M.)

This common species is named as the genotype of a recently-erected genus (*Paradromia*) which is not satisfactorily separated from *Petalomera.*

Reproduction and Development.—The eggs are large and the development is similar to that of the Bristled Sponge-crab, the young hatching as little

Fig. 108.—*Petalomera lateralis* (x 2).

Fig. 109.—Brood young of *Petalomera lateralis* (x 17).

crabs; in this case, however, fewer ova are produced. The young (fig. 109), which pass at least two stages beneath the apron of their mother, have the carapace longer than wide; the clothing, armature, and pleopods are not as in the adult, a subhepatic tooth is not developed, and the antero-lateral teeth are represented by swellings.

Warty Sponge-crab. *Petalomera depressa* (Baker). (depressed).

Very like the preceding species in some respects. There are three to five flattened teeth on the antero-lateral margins, the first being usually larger than the others; there are several tubercles on the subhepatic region. The legs are furnished with knob-like tubercles instead of with ridges as in *P. lateralis*, and the sternal grooves of the female are more convergent (although distinctly separated anteriorly) and reach forward to between the coxae of the chelipeds. Length of carapace: 30 mm., or 1 $^{3}/_{16}$in. (S.A.M.)

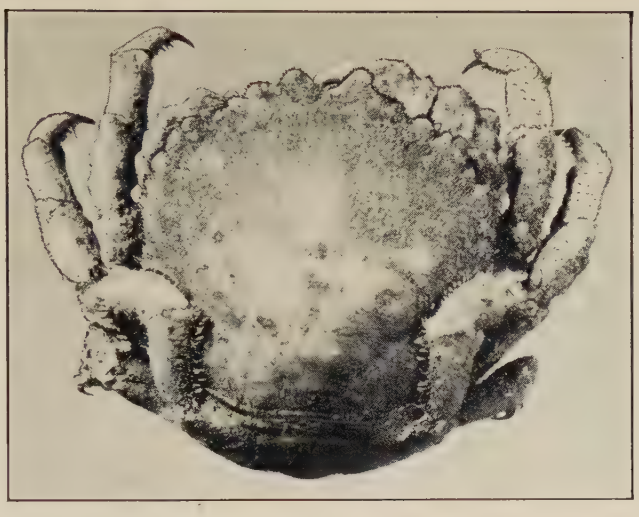


Fig. 110.—*Petalomera depressa* (x 2).

Hairy Sponge-crab. *Petalomera wilsoni* (Fulton & Grant). (personal name).

The carapace is much broader than long; the middle, or rostral, tooth of the front is small and acute, and the two outer teeth are large and blunt.

Fig. 111.—*Petalomera wilsoni* (after Rathbun, x $1\frac{1}{3}$)

There is a tooth at the middle of the upper orbital border, and the angle of the orbit is prominent. The antero-lateral borders are each cut into four teeth (including one behind the cervical groove) and there is a small tubercle on the subhepatic region. The sternal grooves of the female end wide apart, and reach forward to the level of the posterior part of the coxae of the first walking legs. The whole of the body and legs, excepting the dactyli and tips of the fingers, is covered with a dense clothing of hair. The eggs are moderately large, being about .75 mm. in diameter. Length of carapace: 25 mm., or 1in.

Subtribe **HOMOLIDEA.**

Family LATREILLIDAE.

Our one representative is so very distinctive in appearance that there is no chance of confusing it with members of the preceding subtribe.

LATREILLOPSIS (Henderson).

Antlered Crab. *Latreillopsis petterdi* (Grant). (personal name).

This species occurs in deep, or moderately deep water (50 to over 300 fathoms). Superficially it somewhat resembles some of the species of the next tribe—the Spider-crabs—but the dorsal position of the hinder legs at

Fig. 112.—*Latreillopsis petterdi* ($\frac{1}{3}$ nat. size).

once distinguishes it. The carapace is armed with tubercles and spines, and is produced in front to form a simple rostrum. There is a prominent, antler-like spine above each of the large eyes. The legs are long and slender, with the merus spinose. Length of carapace: 60 mm., or $2\frac{3}{8}$in. (S.A.M.)

Tribe **BRACHYGNATHA.**

The tribal name is derived from *brachys* (short) and *gnathos* (a jaw). The species have the mouth frame square, as in the sponge crabs, but the legs of the last pair are rarely reduced in size or carried up on the back; none of the South Australian representatives has the hind legs thus modified, so distinction on this score is easy. In the female the oviducts open on the *sternal* surface, and there is no trace of appendages on the first somite of the abdomen. Our species may be allotted to one or other of the two subtribes at a glance, the shape of the carapace being the most obvious distinguishing character:—

a. Body more or less triangular (rarely subcircular), with the forepart narrow .. .. OXYRHYNCHA.

aa. Body oval, round, or square, with forepart wide.. BRACHYRHYNCHA.

Oxyrhyncha means "sharp-snouted" and Brachyrhyncha "short-snouted," the application being apparent from the characters keyed.

Subtribe **OXYRHYNCHA.**

The Spider-crabs and their allies fall into three families, which are separated by the following characters:—

a. Carapace thin and flat, or almost flat. Genital openings of male on sternum .. .. HYMENOSOMATIDAE.

aa. Carapace neither thin nor flat. Genital openings of male on coxae of last legs.

b. Chelipeds very mobile, usually not much larger than the other legs, and not having the fingers bent at an angle from the palm. Hooked hairs usually present on carapace .. .. MAJIDAE.

bb. Chelipeds not specially mobile, usually much larger and heavier than the other legs, and having the fingers bent at an angle from the palm towards the side on which is the fixed finger .. .. PARTHENOPIDAE.

Family HYMENOSOMATIDAE.

A family of tiny, spider-like crabs which occur under stones on reefs and amongst weed in water of various depths off our coasts. The carapace is almost or quite flat above, and is subcircular or subtriangular in shape, often produced into a rostrum anteriorly. There are no orbits. Our genera are distinguished thus:—

a. Regions of carapace defined by sharp-cut grooves. Ischium of outer maxillipeds not longer, but often much shorter, than merus .. .. *Halicarcinus.*

aa. Regions of carapace not defined by sharp-cut grooves. Ischium of outer maxillipeds longer than merus.

b. Chelipeds of male much stouter than walking legs. Rostrum with a vertical keel on ventral surface so that the front is T-shaped in anterior view .. *Elamena.*

bb. Chelipeds of male slender, not stouter than walking legs. Rostrum with a small tooth or short, low ridge on ventral surface, not T-shaped in front view .. .. (*Elamena*) subgenus *Trigonoplax.*

HALICARCINUS (White).

The outer maxillipeds almost or quite close the buccal cavern, and have the ischium and merus of about the same size. There is a conspicuous epistome. The regions of the carapace are defined by finely-cut grooves and none of the segments of the abdomen of the male is fused. A rostrum —simple, trilobate, or tridentate—is almost always present, although *H. nuytsi* has the front very obtusely and roundly angular, but no distinct rostrum. Three of the marine forms noted in the key below (*H. ovatus, H. rostratus,* and *H. australis*) are common off our coasts, the first-named being exceedingly plentiful. The colour is variable in all these species.

a. Rostrum present.

b. Rostrum tridentate, the teeth of about equal size .. *ovatus.*

bb. Rostrum simple, sometimes with a small and inconspicuous tooth on each side of base.

c. Rostrum long, narrow, and acute .. .. *rostratus.*

cc. Rostrum about as wide as long, the apex obtusely angular.

d. Chelipeds of adult male very large (marine) .. *australis.*

dd. Chelipeds of male small (freshwater) .. .. .. *lacustris.*

aa. Rostrum absent .. .. *nuytsi.*

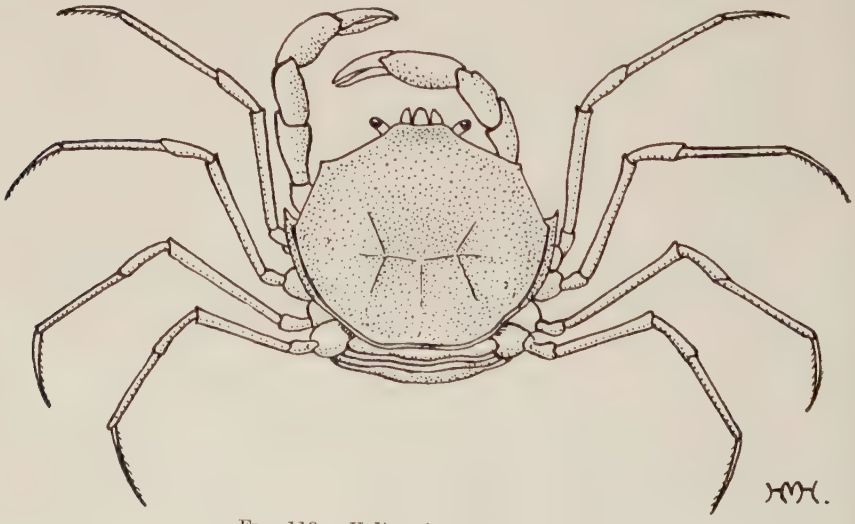


Fig. 113.—*Halicarcinus ovatus* (x 3).

Three-pronged Sea-spider. *Halicarcinus ovatus* (Stimpson). (egg-shaped).

Easily distinguishable from the other species here mentioned by the tridentate form of the short rostrum. There are two small teeth on each lateral margin of the carapace which is slightly wider than long and is concave, flat, or slightly convex above. A female is illustrated; the hands become much larger in the adult male. Length of carapace: 13 mm., or ½in. (S.A.M.)

Beaked Sea-spider. *Halicarcinus rostratus* (Haswell). (beaked).

The flat, slightly convex, or slightly concave carapace is about as long as broad, or rather longer than wide, exclusive of the very narrowly triangular and apically acute rostrum. There is a blunt tooth on each side of the base of the rostrum, a prominent acute tooth behind the eye, and

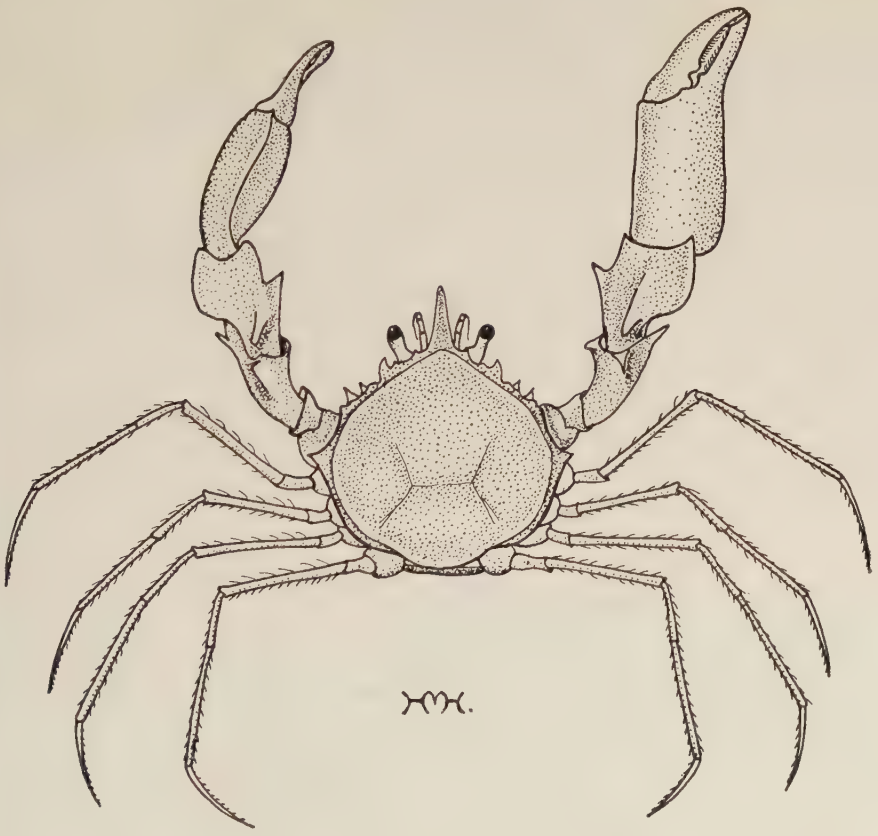


Fig. 114.—*Halicarcinus rostratus* (x 5).

another at about the middle of each lateral margin of the carapace; other more or less distinct, smaller lateral teeth are present. The chelipeds of the male are large and characteristic; the merus has a tooth at the distal end of the upper border, sometimes followed by one or two smaller teeth, and

the carpus bears two or three elevated, tooth-like carinae. The hand is compressed, and the upper margin is furnished with a low crest. The walking legs are long, and more slender than in the other species. Length of carapace: 8 m.m., or $^{5}/_{16}$in. (S.A.M.)

Blunt-nosed Sea-spider. *Halicarcinus australis* (Haswell). (southern).

The suborbiculate, flattened or slightly concave carapace is somewhat broader than long, exclusive of the broad rostrum, which is concave dorsally and terminates apically in a small tubercle. There are often two teeth on each lateral border, but in some specimens one or both may be indistinct

Fig. 115.—*Halicarcinus australis* (after Haswell, slightly enlarged).

or represented by a slight angulation of the carapace. The chelipeds of the male are very large and massive, but are not furnished with tooth-like carinae as in the preceding form. The wrist may have two small spines at the outer angle, and the hand is obscurely keeled below. Length of carapace: 13 mm., or $\frac{1}{2}$in. (S.A.M.)

Fresh-water Spider-crab. *Halicarcinus lacustris* (Chilton). (living in lakes).

A species extraordinarily like *H. australis* in general appearance, but having the chelipeds of the male slender; the last-named form, however, is found only in the sea. Length of carapace: 8 mm., or $^{5}/_{16}$in. (S.A.M.)

Originally described from New Zealand, this tiny crab has been taken on Norfolk Island, in Victoria, and in our State, where it occurs in the River Murray and the Finnis Creek. As noted previously, the River Crab (*Parathelphusa transversa*) and this species are the only truly fresh-water crabs found in South Australia.

Beakless Sea-spider. *Halicarcinus nuytsi* (sp. nov.). (personal name).

The carapace is subcircular, scarcely longer than wide, with no rostrum, there being merely a suggestion of an angle at the middle of the anterior margin; the upper surface is sunken, with well-defined grooves and some low swellings as shown in the figure. There is a spine above the first pair of walking legs, and another on the underside in front of each cheliped.

The eyes are small, and concealed in dorsal view. The outer maxillipeds are broad, almost completely closing the buccal cavern, and with the merus as long as the ischium. The chelipeds are stouter than the walking legs; the fingers meet throughout their length, and are furnished with about seven small interlocking teeth. The walking legs are slender with narrow and but slightly curved dactyli, each terminating in a single small claw. Length of carapace: 6 mm., or ¼in. (S.A.M.)

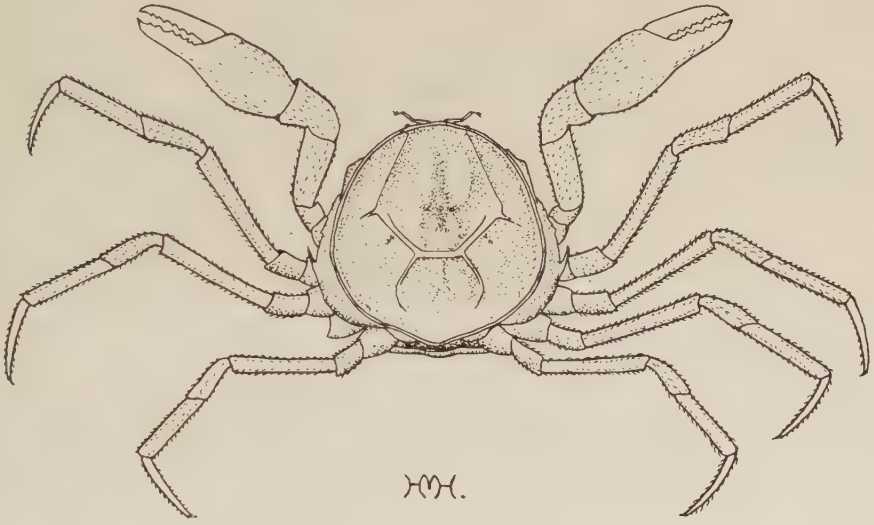


Fig. 116.—*Halicarcinus nuytsi* (x 5).

A single female was dredged off St. Francis Island by Sir Joseph Verco. The species is named in honour of Pieter Nuyts, who discovered and named St. Francis and St. Peter Islands.

ELAMENA (M. Edwards).

The broad outer maxillipeds completely close the buccal cavern, and have the ischium longer than the merus. The regions of the carapace are not defined by fine lines, and at least the third and fourth segments of the male abdomen are fused. The rostrum is truncate or triangular, but never trifid, and the epistome is long.

Blunt-nosed Sea-spider. *Elamena truncata* (Stimpson). (cut off).

Easily recognised by the carapace which is suborbicular in shape with the front (or rostrum) truncate, sometimes very slightly incised medianly. The front is T-shaped in frontal view owing to the presence of a deep, vertical keel on its under surface. There are two angulations on each lateral margin, but no teeth. The chelipeds are slender in the female (which is illustrated), more robust in the male. The abdomen of the female is wide

with the terminal segment truncate. The colour of living examples is said to be brown with four cream markings—a pair towards the middle of the

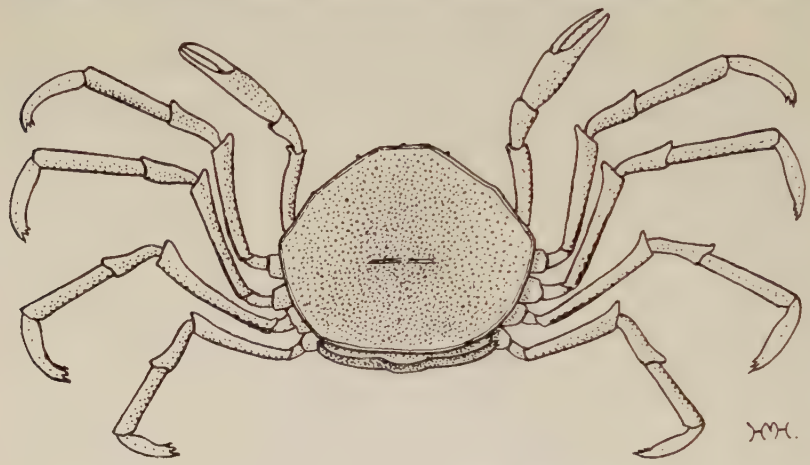


Fig. 117.—*Elamena truncata* (x 3½).

carapace, and one near the base of each of the last pair of legs. Length of carapace: 8 mm., or $^{5}/_{16}$in. (S.A.M.)

TRIGONOPLAX (M. Edwards).

This subgenus of *Elamena* is separated by the characters given in the generic key.

Triangle Crab. *Trigonoplax unguiformis longirostris* (McCulloch) (*unguiformis*, shaped like a claw; *longirostris*, with a long beak).

The carapace is as thin as a wafer, and is triangular in shape with a large rostrum which is concave above and bears a low median ridge on the posterior half of the under surface. The legs are long and slender with the dactyli

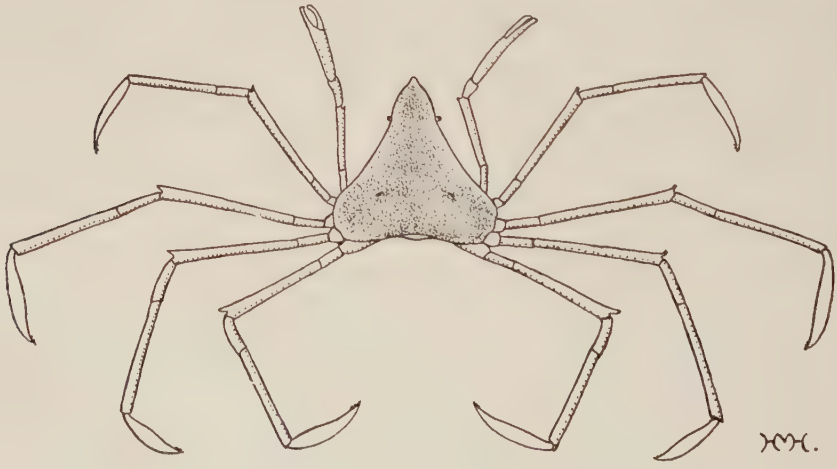


Fig. 118.—*Trigonoplax unguiformis longirostris* (slightly enlarged).

broad. During life the animal is dark chestnut, yellow, or greenish, usually with a short, oblique marking of darker colour on each branchial region. The carapace is a little variable in shape; the lateral margins may be straight, or slightly concave as in the male figured, and the sides of the rostrum may be evenly concave or sinuate. Length of carapace: 17 mm., or $^{11}/_{16}$in. (S.A.M.)

An unmistakable form which lives amongst weed in about two to ten fathoms.

Family MAJIDAE (Spider-crabs).

The curious Spider-crabs, some species of which are amongst the largest of living Crustacea, are placed here; the general appearance of the creatures is familiar to those who have collected along our beaches after storms. The front, which is the apex of the more or less triangular carapace, is very narrow, and is forwardly produced in the form of a simple or forked rostrum; the upper surface of the carapace is often covered with spines and tubercles. As a rule, the orbits are more or less incomplete; the second segment of the second antennae (that is, the basal joint) is large, and is usually fused with the epistome and often with the front.

The masking habit of some of the Spider-crabs is quite as remarkable as that of the Sponge-crabs; the slow-moving creatures are often quite covered with a dense clothing of weed, sponges, or other marine growth, and are often unrecognized by the uninitiated. The back is usually furnished with hooked hairs, which enable the animals to attach fragments of weed and other debris to the carapace. It has been observed than an individual taken from amongst pink weed had this same weed fastened to the carapace, but that when this example was placed amongst green plants, it removed the pink growth and substituted that in harmony with its surroundings. Some species have anything but an inviting appearance during life owing to a dingy covering of marine fibre and silt. The family is divided into four subfamilies:—

a. Basal joint of second antennae usually long and slender. Eyes without orbits. Eyestalks usually long, either non-retractile or retractile against the side of the carapace, or against a postorbital spine which does not conceal the eyes . . . . . INACHINAE.

aa. Basal joint of second antennae not long and slender. Eyes either with orbits, or short and sunk in the sides of the rostrum, or more or less hidden by a pre- or postorbital process.

b. Basal joint of second antennae of moderate width, often broader at base than at apex. Orbits incomplete, never entirely hiding the cornea.

c. Eyes without true orbits. Eyestalks little movable, short, and either concealed by a supraocular spine or sunk in the sides of the rostrum .. ACANTHONYCHINAE.

cc. Eyes with orbits, having a cupped postorbital spine or lobe into which the eye fits when retracted .. PISINAE.

bb. Basal joint of second antennae very broad. Orbits either complete or incomplete, but usually developed enough to conceal the retracted cornea from dorsal view .. .. MAJINAE.

In the specific diagnoses of the Spider-crabs the rostral projection is included in the given length of the carapace.

Subfamily Inachinae.

Our genera may be separated as follows:—

a. Outer maxillipeds somewhat pediform, with the merus usually narrower than the ischium.

b. Carapace triangular, subpentagonal, or pyriform in shape.

c. Carapace well calcified, not depressed.

d. Carapace subpentagonal in shape .. .. *Paratymolus.*

dd. Carapace ovate-triangular in shape .. .. *Achaeopsis.*

cc. Carapace semi-membranaceous, exceedingly depressed and flat .. .. *Oncinopus.*

bb. Carapace nearly circular in shape.

e. Carapace depressed. Hands not very slender and not elongated .. .. *Platymaia.*

ee. Carapace very convex. Hands very slender and elongated .. .. *Cyrtomaia.*

aa. Outer maxillipeds with the merus as wide as, or wider than, the ischium.

f. Carapace subtriangular in shape. First walking legs less than twice as long as carapace.

g. Carapace with prominent lateral spines. Penultimate joints of walking legs more or less compressed and dilated towards distal end .. .. *Naxia.*

gg. Carapace with no prominent lateral spines. Penultimate joints of walking legs not dilated distally.

h. Anterior-external angle of basal joint of second antennae greatly produced and visible from above .. .. *Eruma.*

hh. Anterior-external angle of basal joint of second antennae little produced and not visible from above .. .. *Gonatorhynchus.*

ff. Carapace elongate pyriform, with a long neck. First walking legs greatly developed, more than twice as long as carapace .. *Ephippias.*

PARATYMOLUS (Miers).

Includes a few queer little crabs with a subpentagonal carapace.

Velvet Crab. *Paratymolus latipes quadridentata* (Baker). (*latipes,* with wide legs; *quadridentata,* with four teeth).

The carapace is about as wide as long, and is produced anteriorly to form a bifid rostrum. The antero-lateral margins are each armed with four teeth, the first of which is placed immediately in advance of the eye. The carapace and legs are densely covered with short, fine hairs; the legs are stout; the

Fig. 119.—*Paratymolus latipes quadridentata* (after Baker, x 2½).

wrist of the chela is armed with a large prominent spine, and the outer surface of the hand is granulate and bears a few tiny spines. The eggs are very small and numerous. Length of carapace: 13 mm., or ½in. (S.A.M.)

ACHAEOPSIS (Stimpson).

a. Rostral prongs slender, without small spinules on their sides .. .. *thomsoni.*

aa. Rostral prongs with a few spinules .. .. *ramusculus.*

Long-legged Spider-crab. *Achaeopsis thomsoni* (Norman). (personal name).

The carapace has two slim rostral horns, and the surface is spined, there being two median spines, two spines on each branchial region (the anterior sometimes represented by a tubercle only) and a spine on each protogastric region. There is a slim spine above the eye and one behind the orbit. The chelipeds are long and massive in the male, much smaller in the female; the

Fig. 120.—*Achaeopsis thomsoni* (after Smith, x 2½).

fingers do not gape when closed. There is a small spine at the end of the merus of each walking leg. During life the colour is reddish. Length of carapace: 13.4 mm., or about ½in.

A widely-distributed form, taken in from 55 to over 1,000 fathoms.

Slender Spider-crab. *Achaeopsis ramusculus* (Baker). (a twig).

Fig. 121.—*Achaeopsis ramusculus* (after Baker, x 4).

This may be a variety of the preceding species. The rostral horns are furnished with a few, irregularly arranged spinules, and in the holotype the prongs are bifid apically. The spines of the protogastric regions are reduced to tubercles. Length of carapace: 11 mm., or $^{7}/_{16}$in. (S.A.M.)

ONCINOPUS (de Haan).

Thin-shelled Spider-crab. *Oncinopus aranea* (de Haan). (a spider).

A very spider-like species. The carapace is thin and semi-membranaceous, and has two short rostral lobes; the upper surface and the legs are hairy. The chelae are slender in the female and young male, and the fingers gape

Fig. 122.—*Oncinopus aranea* (x $1\frac{1}{4}$).

narrowly when closed. The second and third legs are long, stout, and very setaceous; the last two pairs are very different, being slender and comparatively short. Length of carapace: 15 mm., or $^{9}/_{16}$in. (S.A.M.)

PLATYMAIA (Miers).

Three-spined Spider-crab. *Platymaia wyvillethomsoni* (Miers). (personal name).

The carapace is subcircular in outline, with three short rostral spines; the surface is spinate in the young, and nearly smooth in old adults. In the female and young male the hands are slender, but in adult males they are swollen and club-shaped, as shown in the figure. The walking legs are very long and slender, with the joints compressed. The colouration varies with

age. "In young males the carapace is red, with or without white points, and the legs are red and white in alternate bands. In the adult the colour is uniform." Length of carapace: 37 mm., or 1½in.

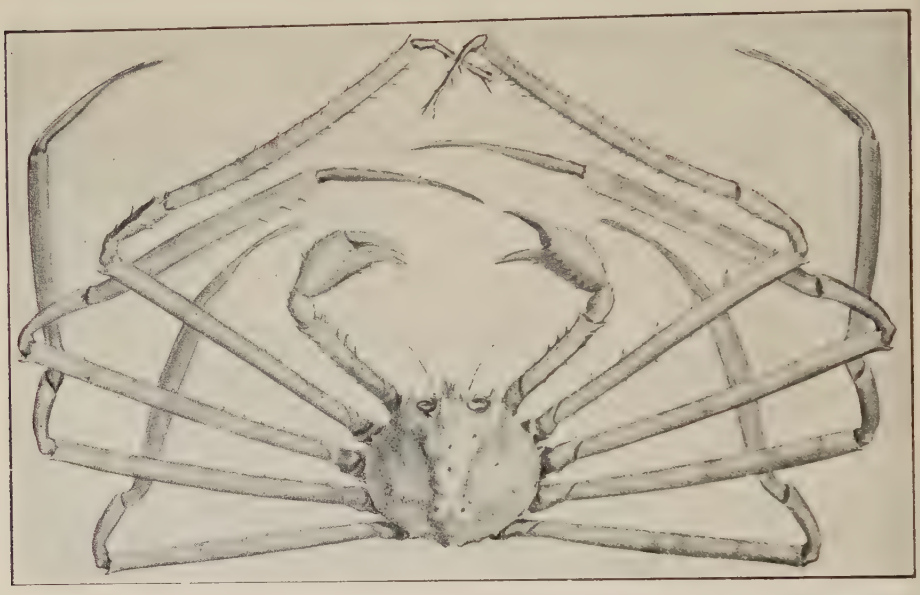


Fig. 123.—*Platymaia wyvillethomsoni* (after Rathbun, $\frac{5}{6}$ nat. size).

CYRTOMAIA (Miers).

Slender-handed Spider-crab. *Cyrtomaia maccullochi* (Rathbun). (personal name).

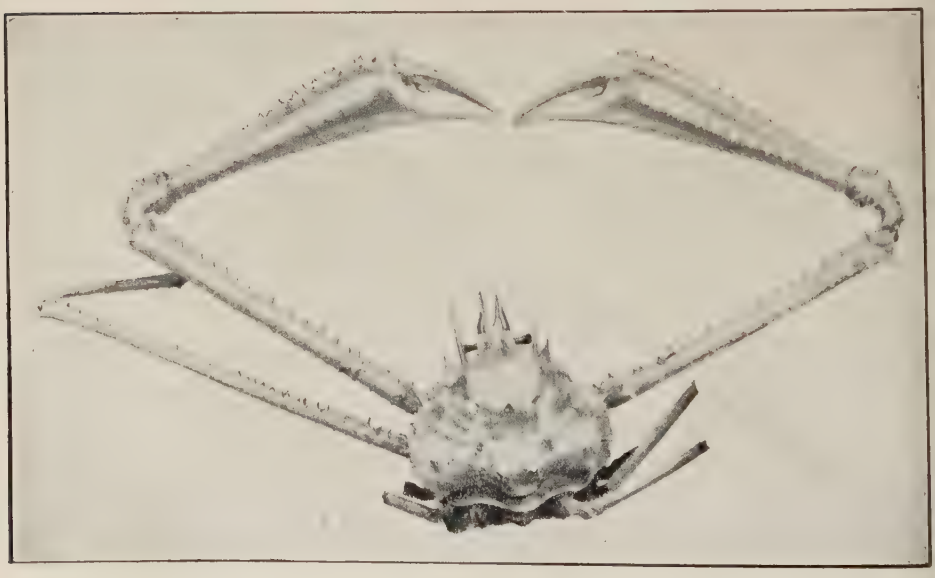


Fig. 124.—*Cyrtomaia maccullochi* (after Rathbun, $\frac{3}{5}$ nat. size).

The carapace is finely roughened with sharp granules, and has two rather slender rostral spines; there are three gastric spines, the median spine being small and the outer spines long, slender, and directed forwards. There is a pair of spines on the cardiac region and two on each branchial region. A male is illustrated; in the female the hands are much smaller and more slender. This species was taken in the Great Australian Bight in from 190 to 450 fathoms. Length of carapace: 48 mm., or 1⅞in.

NAXIA (Leach).

The Spider-crabs most commonly met with in shallow water near our shores belong to this genus. The hands of the male are much larger than those of the female. Four species occur; in all the carapace and legs are well provided with hooked hairs, by means of which weed is attached to the animal. Owing to an often abundant covering of vegetation these crustaceans are known as "Seaweed-crabs"; it is usually necessary to remove the weed in order to determine the species. The weed is fastened to the hooks by the base of the tuft or leaf, thus presenting a natural appearance. The Naxias are slow-moving crabs which lurk amongst weed or under rocks.

a. Propodus of walking legs much widened and truncate at distal end.

b. Spiniform process at outer anterior angle of basal joint of second antenna not denticulate. Carapace with obtusely pointed tubercles on back and with short and thick lateral spines . . . . . *spinosa.*

bb. Spiniform process at outer anterior angle of basal joint of second antennae denticulate on posterior margin (rarely on anterior margin also). Carapace with tubercles and lateral spines shorter and less pointed than in *N. spinosa* . . . . . *tumida.*

aa. Propodus of walking legs less widened and not truncate at distal end.

c. Carapace without pronounced tubercles and with sharp lateral spines. Legs moderately long and slender . . . . . *aurita.*

cc. Carapace with obtusely pointed tubercles and with sharp and slender lateral spines. Legs much longer and more slender . . . . . *aries.*

Spiny Seaweed-crab. *Naxia spinosa* (Hess). (thorny or prickly).

This species attains to the same size as *N. aurita,* and the two are often taken in company on our reefs. They are readily separated by the differences

in the walking legs, and by the character of the surface of the carapace; *N. spinosa* has distinct tubercles, which in *N. aurita* are represented by low prominences capped with tufts of hairs. Length of carapace: 70 mm., or $2\frac{5}{8}$in. (S.A.M.)

Fig. 125.—*Naxia spinosa* ($\frac{2}{3}$ nat. size).

Little Seaweed-crab. *Naxia tumida* (Dana). (swollen).

Fig. 126.—*Naxia tumida* (x $1\frac{1}{2}$).

Very like the preceding species, but differs in the particulars given in the key, and by the fact that the anterior angle of the orbit is less spine-

like; the denticulate anterior spine of the basal antennal joint is characteristic. It is comparatively rarely met with in our gulfs, but is apparently not uncommon on the south coast of Kangaroo Island.

A variety (*gracilipes*, Baker), represented by a single specimen dredged in St. Vincent Gulf, differs from typical examples in having the rostral prongs and the spines longer, a strong median spine on the posterior margin of the carapace, two strong spines on the merus of the chelipeds, etc. Length of carapace: 25 mm., or 1in. (S.A.M.)

Smooth Seaweed-crab. *Naxia aurita* (Latreille). (long-eared).

By far the commonest of the littoral Spider-crabs inhabiting our coasts, and easily recognized by the comparatively smooth carapace, the character

Fig. 127.—*Naxia aurita* ($\frac{2}{3}$ nat. size).

of the walking legs, etc. The males are usually smaller than the females. The colour is yellow, yellowish-brown, or (in localities where green vegetation is abundant) grass-green. Length of carapace: 70 mm., or $2\frac{5}{8}$in. (S.A.M.)

Ramshorn Crab. *Naxia aries* (Guerin). (a ram).

The rostral horns are more divergent anteriorly than in *N. aurita*, the legs are much more slender, and in general appearance the creature is of

delicate and shrunken build. A moderately common species. Length of carapace: 30 mm., or $1\,^{3}/_{16}$in. (S.A.M.)

Fig. 128.—*Naxia aries* (slightly enlarged).

GONATORHYNCHUS (Haswell).

Sea-toad. *Gonatorhynchus tumidus* (Haswell). (swollen).

Fig. 129.—*Gonatorhynchus tumidus* (nat. size).

The surface of the carapace is finely granulate with a few tubercles. There is no preorbital spine; a tiny tooth at the posterior end of the orbital

eave is followed by two slightly convergent spines. There are three or four spine-like lateral tubercles on each branchial region. The eyes are only partly retractile. The anterior limbs of the male are much larger than those of the female; the fingers gape when closed. Occasionally taken on our reefs. Length of carapace: 40 mm., or $1\,^{9}/_{16}$in. (S.A.M.)

ERUMA (McCulloch).

Shaggy Seaweed-crab. *Eruma hispidum* (Baker). (shaggy).

Resembles the preceding species in some respects, but is readily separated by the much more pronounced antero-external angle of the basal antennal joint, the more slender eye-stalks, and the smoother carapace. The rostral prongs are bent down; the eyes are retractile against the sides of the carapace, and are then partly hidden by the postorbital spines. The posterior

Fig. 130.—*Eruma hispidum* ($\frac{2}{3}$ nat. size).

angle of the supraorbital eave is produced to form a small lobe. In the male the chelae are slightly larger than in the female; the fingers gape a little when closed. This species lives near shore, and masks itself with sand, shell-grit, seaweed, etc., to an extraordinary degree. The illustrations show a specimen denuded of hairs and cloak, and an example with a covering of vegetation which renders it quite unrecognizable. Length of carapace: 28.5 mm., or $1\frac{1}{8}$in. (S.A.M.)

EPHIPPIAS (Rathbun).

Endeavour Crab. *Ephippias endeavouri* (Rathbun). (after F.I.S. "Endeavour").

The carapace is much narrowed anteriorly in the male (less so in the female) with two prominent, flat, rostral horns; the hinder part (intestinal region) is produced backwards in a stout blunt process. The elevated portions of the back bear tubercles. The first walking legs are

enormously developed, very stout and more than twice as long as the carapace; the other walking legs rapidly diminish in size backwards. The

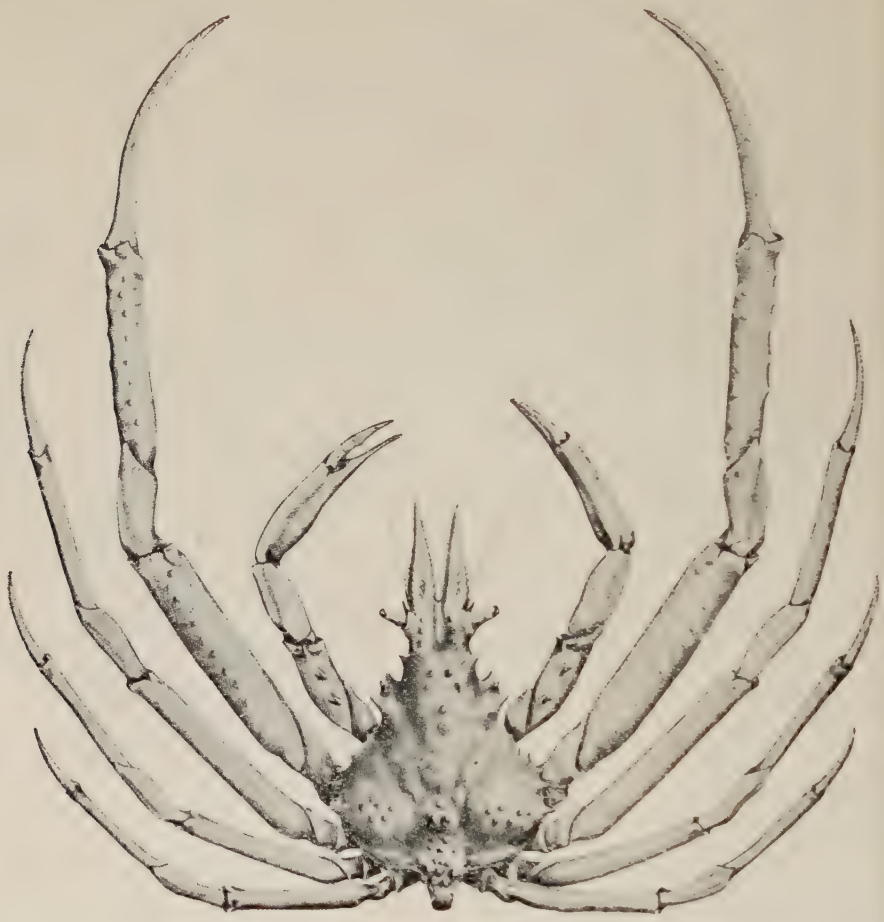


Fig. 131.—*Ephippias endeavouri* (after Rathbun, ½ nat. size).

chelae of the male are not conspicuously enlarged as in the Naxias. A single male and female are known; these were dredged in Investigator Strait. Length of carapace: 111.7 mm., or $4\frac{3}{8}$in.

Subfamily Acanthonychinae.

A single species each of two very different genera occur.

a. Carapace with lateral lobes. Rostrum slender and simple, or bifurcate at tip only . . . . . *Huenia.*

aa. Carapace without lateral lobes. Rostrum formed of two horns . . . . . *Antilibinia.*

HUENIA (de Haan).

Halimeda Crab. *Huenia proteus* (de Haan). (a sea god).

The carapace is depressed, has two low elevations on the mid-line, and is extremely variable in form. In the male it is more or less triangular, and produced on each side into a small lobe, sometimes into two lobes (see illustration). In the female the carapace is usually quadrilobate with large foliaceous lobes. The rostrum is simple, short, or rather long. The chelipeds

Fig. 132.—*Huenia proteus* (nat. size).

are larger in the adult male than in the female. The fingers of females and young males scarcely gape when closed, but those of adult males meet only at their tips. Length of carapace: 23.5 mm., or $^{15}/_{16}$in. (S.A.M.)

More than a score of specimens have been secured in St. Vincent Gulf and Backstairs Passage; some of them have a Bryozoan (*Arachnopusia monoceros*) attached to the carapace. In the tropics the females are found on the sea-weed *Halimeda,* which they resemble in form and colour. The weed *Halimeda* has been collected on the shores of Kangaroo Island and Encounter Bay.

Fig. 133.—*Antilibinia lappacea* (after Rathbun, x 3).

ANTILIBINIA (MacLeay).

Burr Crab. *Antilibinia lappacea* (Rathbun). (*lappa,* a burr).

The carapace is smooth with a long, two-pronged rostrum. A prominent preorbital spine on each side is followed by a postorbital lobe and a

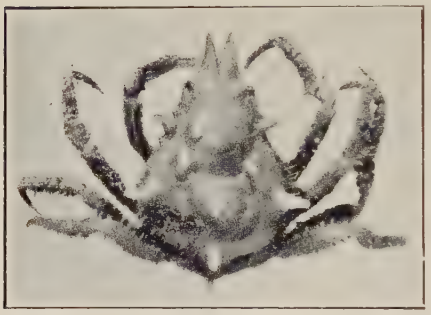
large hepatic spine. There are no branchial spines. This species is known from a single female dredged in the Great Australian Bight in from 200 to 300 fathoms. Length of carapace: 16.5 mm., or $^{21}/_{32}$in.

Subfamily Pisinae.

Only a single species of this subfamily has been recorded from our waters.

DOCLEA (Leach).

Little Thornback Crab. *Doclea profunda* (Rathbun). (deep, in allusion to the depth at which the species was taken).



The carapace is densely covered with short hairs and has a moderately long, two-pronged rostrum. There are six spines on the anterior part of the carapace, two lateral spines, and a posterior median spine. The eggs are few and large. This species was taken in the Great Australian Bight in from 250 to 450 fathoms. Length of carapace: 11.2 mm., or $^{7}/_{16}$in.

FIG. 134.—*Doclea profunda* (after Rathbun, x 3).

Subfamily Majinae.

a. Carapace usually subtriangular (rarely elongate ovate). Rostral horns not deflexed.
  b. Eyestalks moderately long and slender. Upper orbital margin prominent. Rostral horns of moderate length.
    c. With an eave overhanging eye . . . . . *Leptomithrax.*
    cc. With a strong spine overhanging eye . . . . . *Chlorinoides.*
  bb. Eyestalks shorter and stouter. Upper orbital border not prominent. Rostral horns shorter.
    d. Carapace orbiculate triangular. Fingers spooned on inner surfaces (in our one species) . . . *Schizophrys.*
    dd. Carapace elongate ovate (in our one species). Fingers not spooned . . . . . *Eurynome.*
aa. Carapace suboblong. Rostrum vertically or nearly vertically deflexed, usually broad and flat.
    e. Hands of male with palm elongate. Fingers not gaping when closed . . . . . *Micippa.*
    ee. Hands of male with palm short and enlarged. Fingers meeting only at tips when closed *Paramicippa.*

LEPTOMITHRAX (Miers).

The orbit is fairly complete, being roofed in by a supraorbital eave (which has its posterior angle produced); behind this is a prominent postorbital lobe, which is scooped out to receive the end of the eye; between the eave and the postorbital lobe is a smaller "intermediate spine." Our three species are separated as follows:—

a. Postorbital lobe acute, not truncate, but with a small spine on the outer margin a little distance from the tip.
  b. Rostral horns short and stout. Legs of moderate size, the first walking leg about one and one-half times as long as carapace . . . . . *australiensis.*
  bb. Rostral horns more slender. Legs long and slender, the first walking leg about twice as long as carapace . . . . . *globifer.*
aa. Postorbital lobe truncate and bifid at tip, the two terminal teeth equally prominent . . . . . *sternocostulatus.*

Great Spider-crab. *Leptomithrax australiensis* (Miers). (Australian).

The carapace is furnished with many short, unequal, and acute spines, which are often much eroded in old examples; there is a semicircle of four

Fig. 135.—*Leptomithrax australiensis*, senile male (¼ nat. size).

rather prominent spines on each branchial region. The chelae are not very robust in the females and young males, but in old males become greatly enlarged. This species is common in our waters from shore to at least 450 fathoms. It is red during life, with the fingers and underside of the hand yellow. The creature is sluggish in habit, and specimens secured in our

Gulfs are often thickly encrusted with a variety of marine life, such as oysters (fig. 12), worms, Bryozoans, sponges, Ascidians, and so on. Often the fine fibres macerated from dead plants become entangled amongst the spines, forming a mat which collects a mass of silt. A curious circumstance in connection with this crab which, apparently, has not been recorded is that after heavy storms in the autumn and spring large examples are cast up on some of our beaches, occasionally in considerable numbers; almost invariably these stranded crabs are males with strangely deformed fingers. The last named do not meet as in normal examples, but are more or less hooked, often much attenuated, and are crossed, being thus utterly useless as pincers (fig. 135). The crossed fingers of the senile males is a very constant feature, and is not confined to occasional specimens. Length of carapace: 165 mm., or 6½in. (S.A.M.)

Swollen Spider-crab. *Leptomithrax globifer* (Rathbun). (sphere like).

A species very like the preceding, but having longer legs, more slender and divergent rostral horns, and a more conspicuous swelling on the merus

Fig. 136.—*Leptomithrax globifer* (after Rathbun, ½ nat. size).

of the outer maxillipeds. It lives in the Great Australian Bight, where specimens have been taken in from 80 to 120 fathoms. Length of carapace: 86.6 mm., or $3\,^{7}/_{16}$in. (S.A.M.)

Ribbed Spider-crab. *Leptomithrax sternocostulatus* (M. Edwards). (with ribbed sternum).

The specific name refers to a characteristic feature of the male, which has peculiar cavities in the sternum. This species is easily recognized by the form of the postorbital lobe or cup, which has a truncate and bidentate

Fig. 137.—*Leptomithrax sternocostulatus* (⅔ nat. size).

tip, there are three long, submarginal spines on the branchial region. The crab is not at all rare; it is commonly encrusted with marine animals or weed. Length of carapace: 51 mm., or 2in. (S.A.M.)

CHLORINOIDES (Haswell).

The eye is overhung by a strong, bifid spine or hood; a postorbital lobe, and an intermediate spine as in *Leptomithrax*.

Horned Thornback Crab. *Chlorinoides spatulifer* (Haswell). (like a leaf).

The rostral prongs are slender and widely divergent; there are four spines on the mid-line of the carapace. The first

Fig. 138.—*Chlorinoides spatulifer* (x 2).

two are acute, and are situate on the gastric region; the third, on the cardiac region, is broad, compressed and bifid. The fourth, on the posterior or intestinal region, is flattened and usually heart-shaped and simple; the specific name alludes to the shape of this last spine. There are two long lateral spines on each branchial region. Length of carapace: 25 mm., or 1in. (S.A.M.)

SCHIZOPHRYS (White).

The supraorbital eave and intermediate spine are not prominent as in the preceding genera of the subfamily. The postorbital spine is cupped to receive the eye when folded back, and the rostral horns have one or more accesory spines on the outer margins.

Red Sea-toad. *Schizophrys aspera* (M. Edwards). (rough or rugged).

The carapace is rather smoothly granular, with five or six short lateral spines; the rostral prongs are short, slightly incurved or parallel, and have

Fig. 139.—*Schizophrys aspera* (⅔ nat. size).

one spinule on the outer margin. In old males the chelipeds are much enlarged, and the inner surface of the fingers is more deeply channelled than in young males and females. Specimens taken in the Great Australian Bight are considerably more elongate than the example illustrated, and, like individuals from the Northern Territory, have some of the granules of the carapace enlarged, and the lateral spines and rostral prongs longer than in the variety found in our Gulfs. The last named (the smooth and robust form) is very common. During life it is red above, with the palms of the chelae orange-red and the distal part of the fingers white. Below it is largely covered with a dingy tomentum. The crab is often found below rocks which have the under surface covered with a growth of the same

colour as the crustacean; when small sponges are also attached to a stone, numbers of similar sponges are found on the carapace and legs of the crab. Length of carapace: 51 mm., or 2in. (S.A.M.)

EURYNOME (Leach).

Granulate Spider-crab. *Eurynome granulosa* (Baker). (with granules).

The body is clothed with short fur, which holds mud. The carapace is elongate, with large, spaced granules, some of which are tuberculiform. The rostral prongs are short and well separated. A not very conspicuous

Fig. 140.—*Eurynome granulosa* (after Baker, x 3).

orbital eave is followed by a postorbital lobe; between the two an intermediate spine is separated by a closed fissure. A single complete example and some carapaces have been obtained in 100 fathoms or more. Length of carapace: 8 mm., or $^{5}/_{16}$in. (S.A.M.)

MICIPPA (Leach).

The species of this and the following genus are characterized by a flat and deflexed rostrum.

Flat-beaked Crab. *Micippa philyra nodulifera* (Baker). (*Philyra,* a nymph; *nodulifera,* knobby).

The front, or rostrum, is strongly bent down and terminates in four acute teeth; the orbits are nearly complete. Granules and conspicuous nodules are present on the surface of the carapace. Owing to the outstanding supraorbital eaves

Fig. 141.—*Micippa philyra nodulifera* (x 3).

and the deflexed rostrum the carapace has a widened appearance anteriorly. This little form, a variety of the variable *M. philyra,* is rare. Length: 10 mm., or $\frac{3}{8}$in. (S.A.M.)

PARAMICIPPA (M. Edwards).

In this genus the fingers meet only at the tips, whereas in *Micippa* they do not gape when closed. Two easily separated species occur.

a. Carapace orbiculate triangular. Eyestalks long and slender. Basal antennal joint small; lower orbital wall not defined . . . . . *tuberculosa.*

aa. Carapace somewhat squarish in outline, less narrowed between eyes. Eyestalks stouter. Basal antennal joint wide, the lower orbital wall well defined . . . . *spinosa.*

Beaded Flat-beaked Crab. *Paramicippa tuberculosa* (M. Edwards). (with tubercles).

The carapace is narrow between the long and slender eyes, and is covered with numerous compound tubercles, some of which, particularly the lateral ones, are spiniform. In the young, and frequently in the adult, five or six lateral spine-like tubercles (not counting a bifid postorbital spine) are

Fig. 142.—*Paramicippa tuberculosa* (nat. size).

much more prominent than the dorsal tubercles. There are two flat, truncate, deflexed rostral horns, the inner edges of which bear a row of tubercles. The creature is well provided with hooked hairs, and during life is always covered with debris in harmony with its surroundings. The eggs are large and numerous. This species seems scarcely to be congeneric with the following; a male and female are illustrated. Length of carapace: 20 mm., or $^{25}/_{32}$in. (S.A.M.)

Spiny Flat-beaked Crab. *Paramicippa spinosa* (Stimpson). (prickly).

The supraorbital eaves are prominent, and the carapace is wide across the orbital regions. The back is closely granular and hairy, and has three

prominent spines on the median line, and one on the branchial region. There are small spines on the lateral and posterior margins. The rostrum is flat, curved, and bent down, slightly widened anteriorly, with the margins

Fig. 143.—*Paramicippa spinosa* (x 1½).

crenulate and with two small median teeth. Length of carapace: 24 mm., or $^{15}/_{16}$in. (S.A.M.)

A small variety of this species (var. *affinis* Miers) has also been taken in our waters. The variety is distinguished by the absence of spines on the back, and by a slight difference in the form of the rostrum.

Family PARTHENOPIDAE.

As previously noted, the members of this family have the movable finger bent on the hand, at an angle towards the side on which the fixed finger is set. The orbits are well made and almost circular.

a. Carapace and legs of an eroded appearance. Carapace broadly subtriangular in shape . . . . . *Thyrolambrus.*

aa. Carapace and legs not eroded. Carapace more or less pentagonal in shape.

b. Carapace ovate-pentagonal in shape, with small rounded tubercles . . . . . *Trichia.*

bb. Carapace sharply pentagonal with the antero-lateral and postero-lateral borders strongly produced; granulate with raised bosses . . . . . *Ceratocarcinus.*

THYROLAMBRUS (Rathbun).

The outer maxillipeds are broad, fitting closely together on their inner edges. The chelipeds are moderately long.

Eroded Crab. *Thyrolambrus excavatus* (Baker). (hollowed).

The body is irregularly granulated, ridged, and deeply eroded. On the walking legs some of the granules are jagged. The carapace is subtriangular, with the front deflexed; the posterior margin is short and straight,

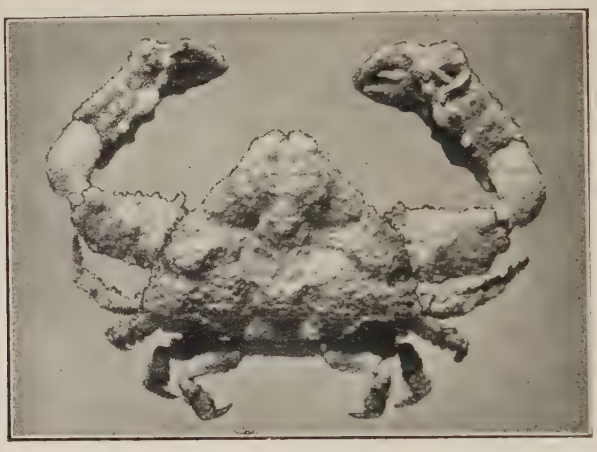


Fig. 144.—*Thyrolambrus excavatus* (x 1½).

and the postero-lateral margins are slightly incised. The hands are moderately robust, with several compressed spines on the lower margin, and the inner face bears three compressed processes, the middle of which is much the largest. Length of carapace: 19 mm., or ¾in. (S.A.M.)

TRICHIA (De Haan).

The outer maxillipeds do not fit closely together along their inner edges, but a large triangular space is left between the ischium joints. The chelae are shorter and stouter than in *Thyrolambrus*.

Long-haired Crab. *Trichia dromiaeformis australis* (Baker). (*dromiaeformis*, like a *Dromia*—a sponge-crab; *australis*, southern).

The body is strongly and almost uniformly granulate, with well-defined regions. There are indications that during life the animal is densely clothed with fairly long hairs. The front is prominent and slightly deflexed, and is divided by a median furrow into two lobes, each of which is cut into rather deeply below by the fossettes of the first antennae. Only a single specimen,

the male illustrated, is known to science. Length: 18 mm., or $^{11}/_{16}$in. (S.A.M.)

This form is here treated as a variety of *T. dromiaeformis*, an excessively hairy crab which has been taken in Japan and Queensland. This species has the tubercles of less uniform size, with larger smooth interspaces between

Fig. 145.—*Trichia dromiaeformis australis* (x 1½).

the regions, the walking legs smoother, and the conical projections of the merus, wrist, and hand of the chelipeds much more developed than in the South Australian variety.

CERATOCARCINUS (Adams & White).

Gouty Crab. *Ceratocarcinus dilatatus* (M. Edwards). (dilated).

The carapace and the long chelipeds are finely granulate; the last named are longitudinally grooved. There is a sharp tubercle, or boss, behind each

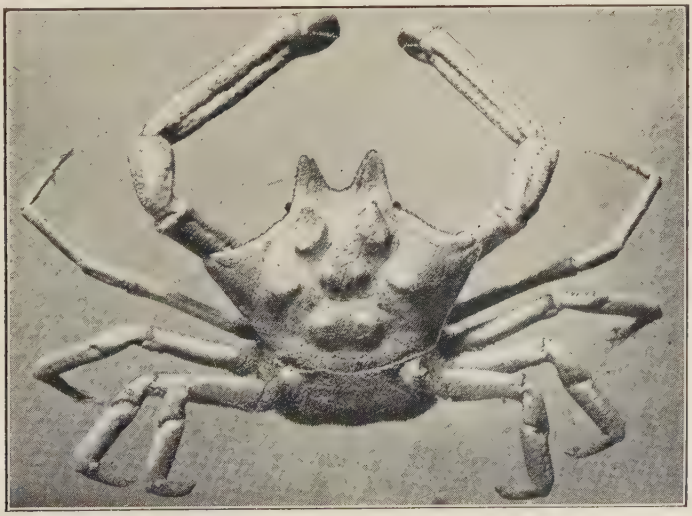


Fig. 146.—*Ceratocarcinus dilatatus* (x 2½).

of the prominent rostral horns; as shown in the figure, there is also a boss on each branchial region, and a pair of tubercles on the mesogastric and cardiac regions. The granulations and bosses are more or less hidden by a short pubescence. This queer species has been dredged in the Great Australian Bight. Length of carapace: 11 mm., or $^{7}/_{16}$in. (S.A.M.)

Subtribe **BRACHYRHYNCHA.**

This subtribe includes most of the known crabs of the world. The characters given in the tribal key distinguish the "short-snouted crabs" from the sponge-crabs, and the following characters separate them from the spider-crabs composing the previous suborder:—The carapace is oval, round, or squarish, and the front is either rounded or square cut, and is not, or only slightly, produced forwards as a rostrum. The number and diversity of the species having these features in common renders it necessary to subdivide the Brachyrhyncha into several families, some of which contain a very large number of representatives:—

a. Carapace elongate-oval with a distinct rostrum. Orbits more or less incomplete. Flagella of second antenna long and hairy . . . . . EURYALIDAE.

aa. Carapace rarely elongate-oval, often without rostrum. Orbits complete, though fissures may remain. Flagella of second antennae not hairy, as a rule short.

b. Palp of third maxillipeds articulates at or near antero-internal angle of merus. Body usually round or transversely oval. Male openings almost always on coxae. Right cheliped often larger than left.

c. Legs more or less distinctly adapted for swimming PORTUNIDAE.

cc. Legs not adapted for swimming, or, if so modified, then the vas deferens opens on sternum, or runs in a sternal groove.

d. Freshwater crabs, with the branchial region greatly swollen . . . . . POTAMONIDAE.

dd. Marine crabs with the brancial regions not greatly swollen.

e. Body usually transversely oval. Male openings rarely on sternum . . . . . XANTHIDAE.

ee. Body usually squarish. Male openings on sternum, or if on coxae the ducts pass along a groove in the sternum. (Not sharply separated from foregoing family.) GONEPLACIDAE.

bb. Palp of third maxillipeds not articulating at or near antero-internal angle of merus. Body usually more or less square. Male openings on sternum. Right chela not uniformly larger than left in any species.

f. Carapace more or less rounded with small orbits; eyes small. (Small crabs living as commensals in other animals.) . . . . PINNOTHERIDAE.

ff. Carapace usually squarish; eyes not specially reduced. (Free-living crabs.)

g. Front broad, or moderately broad. A gap between the third maxillipeds . . . . . GRAPSIDAE.

gg. Front narrow, or moderately narrow. Third maxillipeds almost or quite close the mouth . . . . . OCYPODIDAE.

Family EURYALIDAE.

GOMEZA (Gray).

In the majority of crabs the lashes of the second antennae are very short. Here, however, they are long and slender, and each bears a double fringe of hairs on the inner surface. When the two flagella are brought together the hairs intermesh, and the lashes thus form a tube. These crabs burrow in sand, and when they are buried, water is conveyed through this tube to or from the branchial chambers. It has been shown that in an allied European form (*Corystes cassivelaunus*) the normal direction of the respiratory current is reversed when the creature is buried, the water passing down the antennal tube into the gill-cavities and out at the openings at the base of the chelipeds.

Masked Burrowing-crab.
Gomeza bicornis (Gray). (with two horns).

This unmistakable little crab has been dredged alive in St. Vincent Gulf, and carapaces are occasionally cast up on our beaches. The lateral margins of the elongate carapace are furnished with spines, and the front is produced into

FIG. 147.—*Gomeza bicornis* (nat. size).

a rostrum which is medianly furrowed and incised at apex; on each side of the rostrum is a prominent spine. The back is clothed with short hairs; they do not hide the furrows which faintly simulate a queer human face; in small examples this "face" is more distinct than in large specimens. According to a colour sketch made by a South Australian collector, the carapace is red during life, with the antero-lateral parts tinged with brown, and the branchial regions yellow; the antennae and chelipeds are brown, and the other legs yellow. Length of carapace: 35 mm., or $1\frac{3}{8}$in. (S.A.M.)

Family PORTUNIDAE.

The carapace is usually wider than long, and generally widest at the last of the spines of the antero-lateral margins. The terminal joints of the last legs are more or less flattened for swimming. Five of the subfamilies into which the Portunidae is divided are represented.

a. Last pair of legs with the terminal joint flattened and expanded to form a suboval or broadly lanceolate swimming paddle.
  b. Basal joint of second antennae not very wide.
    c. Chelipeds longer than any of walking legs. . . . . CARUPINAE.
    cc. At least one of the walking legs as long as the chelipeds . . . . . LIOCARCININAE.
  bb. Basal joint of second antennae very wide.
    d. Flagellum of second antennae not shut out from the orbits by processes of the basal joint . . . . PORTUNINAE.
    dd. Flagellum of second antennae shut out from orbits by processes of the basal joint . . . . . THALAMITINAE.
aa. Last pair of legs with terminal joint flattened and sickle-shaped . . . . . CARCINIDINAE.

Subfamily Carupinae.

LISSOCARCINUS (Adams & White).

Little Swimming-crab. *Lissocarcinus polybioides* (Adams & White). (like many others).

The carapace is as long as broad, smooth excepting for a ridge near the last antero-lateral tooth. The front projects well beyond the inner supra-orbital angles and is broadly triangular with a median notch. Each antero-lateral margin is curved and cut into five teeth, the first forming the outer angle of the orbit. The chelipeds are stouter and longer than the other limbs. This small crab is rare off our coasts. Length of carapace: 7 mm., or $^{9}/_{32}$in.

Subfamily Liocarcininae.

a. Terminal joint of last pair of legs suboval, with apex rounded . . . . . *Ovalipes.*

aa. Terminal joint of last pair of legs broadly lanceolate, with apex acute . . . . . *Liocarcinus.*

OVALIPES (Rathbun).

Sand-crab or Sandy. *Ovalipes bipustulatus* (M. Edwards). (with two blisters).

The carapace is longer than wide excepting in very juvenile examples. The front is cut into four small teeth and the antero-lateral margins into five, not including a small tooth inside the first of the last named. The first walking legs are as long as the chelipeds, and the last two joints of the fifth pair of legs are flattened for swimming. A characteristic feature is

Fig. 148.—*Ovalipes bipustulatus* ($\frac{3}{7}$ nat. size).

the presence of a large spot near each postero-lateral angle of the carapace; these blotches usually persist in dead specimens, but change to red. During life the colouration of adult specimens is as follows:—The back is bluish-gray with a few white markings and the granules pale brown; the hinder part of the carapace is bluish with the aforementioned blotches dark violet. The eyestalks and both pairs of antennae are white; the chelipeds are pale grey or white with the tubercles of the upper and inner surfaces reddish, and the inside of the merus and wrist marked with violet. The walking

legs are gray, faintly mottled. The upper margin of the inner lobe of the carpus of the last leg is violet; the flattened oval dactylus is bluish on the posterior half, margined with violet and with the short fringing hairs brown. Younger examples are paler with the dorsal spots ill defined. Length of carapace: 70 mm., or $2\frac{3}{4}$in. (S.A.M.)

The Sand-crab is common on sandy bottoms around our coasts: it quickly buries itself when disturbed in shallow water, the last legs then acting as shovels. Mr. McNeill, of the Australian Museum, states that the crabs lie buried in the sand and attack prawn-baits of line fishermen; they cling tenaciously to these baits, and are then easily withdrawn from their concealment. He also notes that the species is apparently more active at night than in the daytime. The crab is not valued as food.

LIOCARCINUS (Stimpson).

Ridged Swimming-crab. *Liocarcinus corrugatus* (Pennant). (wrinkled).

A rather small species, the carapace of which is a little wider than long, with the regions well defined and marked with transverse ridges. The front is cut into three teeth (the median of which is right-angled or obtuse),

Fig. 149.—*Liocarcinus corrugatus* (about nat. size).

and the antero-lateral margins are each cut into five acute teeth. There is a strong spine at the inner angle of the wrist, and the upper border of the palm is armed with a spine. The hands are ridged, and bear tubercles arranged in squamiform series. Length of carapace: 26 mm., or 1in. (S.A.M.)

Allied species are sometimes popularly known as Fiddler-crabs; it is stated that this name is applied because of the movements made by the crabs while swimming.

Subfamily Portuninae.

PORTUNUS (Fabricius).

Our two representatives, both of which are valued as food, are separated as follows:—

a. A spine at distal end of lower border of merus of chelipeds . . . . . *pelagicus.*

aa. No spine at distal end of lower border of merus of chelipeds . . . . . *sanguinolentus.*

Blue Swimming-crab or Bluey. *Portunus pelagicus* (Linnaeus). (pelagic).

The carapace is very broad, about twice as wide as long, and covered with large granules; the front is cut into four teeth, not counting the inner orbital angle, and the antero-lateral margins (including the outer orbital angle) are armed with nine teeth, the last of which is very large. In adult

FIG. 150.—*Portunus pelagicus* ($\frac{1}{4}$ nat. size).

males the chelipeds are three times as long as the carapace; in young males and females they are a little shorter. The arm, or merus, is furnished with three or four large spines on the upper margin, and one at the end of the lower (or hinder) margin. The carapace is sometimes covered with dense pubescence, Blue, with paler mottlings, during life. Length of carapace: 83 mm., or $3\frac{1}{4}$in. (S.A.M.)

This widely distributed crustacean is the Blue-crab of Adelaide markets. At certain times it occurs in countless thousands in the shallow waters of our Gulfs, particularly in autumn: in occasional specimens the carapace attains a length of nearly 4in., but such examples are rare. In the autumn of 1926 Blue-crabs were particularly numerous, and at the Outer Harbour a party "pulled out three or four at a time until their arms

ached. They collected about 40 dozen.'' Some members of the party were line fishing but ''the crabs were so numerous that no sooner did one get his hook in the water (baited for whiting) than along came a crab.'' St. Kilda, 17 miles north of Adelaide, is noted as a ''crabbing'' resort. The species mates inshore at this place, and is captured in numbers at low tide. It buries itself in the sand with rapidity; when thus concealed, however, there is evidence of its presence in the shape of a low depression. Fishermen armed with dab-nets poke at the depressions, and the crab immediately protrudes the chelae from the sand, and is scooped into the net. The crabs are also captured from jetties and boats with baited nets and with an apparatus known as a ''jigger.'' The last-named resembles a wheel without a rim; it consists of a weighted hub from which radiate a number of wire spokes; a large fish-hook is soldered at the end of each spoke. The jigger is baited in the centre, and the crabs attain the bait by crawling over the inwardly directed hooks. When the apparatus is jerked upwards the crabs are caught on the hooks.

Red-spotted Swimming-crab. *Portunus sanguinolentus* (Herbst). (bloody).

This, like the preceding, is a large species, but is comparatively rare in South Australian waters. It is common at the Hawaiian Islands, where it

Fig. 151.—*Portunus sanguinolentus* ($\frac{1}{2}$ nat. size).

is used as food. The absence of a spine at the far end of the lower border of the arm, and the presence of three blood-red spots on the back, distinguish it from the Blue-crab, which it greatly resembles in most structural features. Length of carapace: 66 mm., or $2\frac{5}{8}$in. (S.A.M.)

Subfamily Thalamitinae.

Two species have been collected in South Australian waters, but both are rare here.

a. Front cut into four lobes, not including the broad supra-orbital lobe . . . . . *intermedia.*

aa. Front cut into only two lobes, not including the broad supraorbital lobe . . . . . *sima.*

Six-lobed Crab. *Thalamita intermedia* (Miers). (intermediate).

The carapace is broad, covered with whitish pubescence, and is crossed by some rather faint transverse ridges. Of the frontal lobes the median two are smallest. There are five well-developed spines on the antero-lateral margins. The arm of the chelipeds has three spines on the front

Fig. 152.—*Thalamita intermedia* (x $1\frac{1}{2}$).

margin, the wrist has a strong spine on the inner edge, and three smaller thorns on the outer surface. The hand has three or four spines on the upper side, and three granulated ridges on the outer face. A specimen from the Great Australian Bight is illustrated. Length of carapace: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

Four-lobed Crab. *Thalamita sima* (M. Edwards). (pug-nosed).

Readily separated from the foregoing species by the character of the front, which (including the lobe over the eye) is four lobed. The antero-lateral margins are cut into five teeth. The chelipeds are granular, with the hand

and under surface covered with transverse squamae: there are small spines on the outer face of the wrist, and five distinct spines on the upper surface of the hand. Length of carapace: 16 mm., or ⅝in.

Subfamily Carcinidinae.

NECTOCARCINUS (M. Edwards).

Two species occur.

a. Front unbroken or with only a tiny median notch; without numerous spiniform tubercles on anterior part of carapace, wrists, and hands .. .. *integrifrons.*

aa. Front divided into two denticulated lobes; with numerous spiniform tubercles on anterior part of carapace, wrists, and hands .. .. *tuberculosus.*

Rock-crab or Rocky. *Nectocarcinus integrifrons* (Latreille). (with an unbroken front).

The surface of the carapace is granulate, and the regions are well defined: the antero-lateral margins are armed with four teeth, including the outer orbital angle. The chelipeds are marked with scale-like ridges and granules: there is a strong inner spine on the wrist. Some specimens, particularly young examples, are clothed with rather dense hairs. The colouration is characteristic, the anterior two-thirds or so of the carapace being dark

Fig. 153.—*Nectocarcinus integrifrons* (Latr.) (Nat. size).

purplish-brown, the remainder pale yellowish-brown. The wrist and hand are purplish-brown above, paler below, and the greater part of the fingers is black. Length of carapace: 70 mm., or 2¾in. (S.A.M.)

This very common crab is occasionally caught in crab-nets, but is not used as food. Our large Sting-rays (*Dasyatis brevicaudatus*) consume considerable quantities. In old examples the crushing power of the large chela is considerable, as anyone who has had the misfortune to be nipped can testify; at the base of the finger and thumb is a pair of large opposed tubercles, probably utilised for crushing shellfish. These tubercles are often considerably ground down in large specimens, and have much the appearance of worn molar teeth.

The species is frequently washed up on St. Vincent Gulf beaches, and it is noteworthy that specimens secured thus are usually old males with large chelipeds; adult females, curiously enough, are seldom cast up. Occasionally an example infested with Rhizocephalid parasites is met with (fig. 4). As mentioned in Chapter I., the Rhizocephalids are very degenerate barnacles which have forsaken the usual habits of their group.

Rough Rock-crab. *Nectocarcinus tuberculosus* (M. Edwards). (with tubercles).

Very easily separated from the preceding species by the rougher appearance of the carapace and legs, due to the presence of spiniform tubercles, as

Fig. 154.—*Nectocarcinus tuberculosus* ($\frac{1}{3}$ nat. size).

noted in the key. This crab is not rare in our waters, but is by no means as plentiful as *N. integrifrons*. Length of carapace: 76 mm., or 3in. (S.A.M.)

Family POTAMONIDAE.

Embraces crabs which live in fresh-water or in damp forests. The branchial regions of the carapace are swollen, and the dactyli of the walking legs bear tiny spines.

PARATHELPHUSA (M. Edwards).

River-crab. *Parathelphusa transversa* (von Martens). (transverse, *i.e.*, wider than long).

The surface is punctate; the front of the carapace is medianly concave, and on each side there is a small tooth behind the outer angle of the orbit. The fingers of the chelae do not gape when closed, and the wrist is armed with two spines. The colour is olivaceous or brown during life. Length of carapace: 38 mm., or 1½in. (S.A.M.)

Fig. 155.—*Parathelphusa transversa* (⅔ nat. size).

Only two crabs are found in the fresh-waters of our State—the tiny Spider-crab (*Halicarcinus lacustris*) which occurs only in the southern parts, and this River-crab which lives in the arid, far northern districts of

South Australia. It may be well to mention that the Smooth Shore-crab (*Cyclograpsus audouinii*) has been confused with the River-crab by collectors and others. The Smooth Shore-crab is a marine species which makes its way into estuarine waters, and is sometimes found at some distance from the sea-coast on the banks of brackish streams; it superficially resembles the River-crab, but the last-named is never found in the south.

The River-crab excavates burrows in the banks of our northern streams, and during dry spells aestivates a couple of feet below the surface of mud or sand in the same way as the common fresh-water crayfish or Yabbie. The large, curved chelae of the crab are used for digging, the sand being scraped together in a more or less spherical mass. As each little heap is compacted it is lifted with the fore-limbs and deposited at the mouth of the burrow; the masses are arranged around the entrance so as to form a low crater, the interior of which is smoothed with the outside of the hands. The finger and thumb action of the chelae is daintily used in feeding, but not in excavating. This crab is easily maintained in a damp terrarium, where it will feed on scraped beef, earthworms, and so on, but in captivity is apt to die just before or after a moult.

Family XANTHIDAE.

A family of crabs in which the carapace is wider than long and generally more or less oval in shape. The front is moderately wide and when (as is often the case) it is divided into teeth, there is a median notch. The fingers are usually slightly curved. The genital openings of the male are almost always situate on the coxae of the last pair of legs. Four of the subfamilies are represented in South Australia:—

a. The ridges on the endostome (or palate) which define the channels leading from the branchial chambers are absent or low, and do not reach to the anterior part of the buccal cavern.

b. Carapace not profusely lobulated . . . . . XANTHINAE.

bb. Carapace usually profusely and deeply lobulated, and granular . . . . . ACTAEINAE.

aa. The ridges on the endostome extend to the anterior margin of the buccal cavern, and are often strong.

c. Basal joint of second antennae broadly in contact with the front . . . . . OZIINAE.

cc. Basal joint of second antennae not touching, or only just meeting the front . . . . . PILUMNINAE.

To ascertain the character of the ridges of the palate it is necessary to push the oral appendages to one side.

Subfamily Xanthinae.

Two genera are represented:—

a. Front entire; antero-lateral margins of carapace cut into shallow lobes. Merus of legs unarmed . . . . . *Megametope.*

aa. Front cut into four teeth; antero-lateral margins of carapace toothed. Merus of legs with a row of spines on upper (or anterior) margin . . . . . *Pseudocarcinus.*

MEGAMETOPE (Filhol).

Three species of this genus are known, and two of them occur in our Gulfs:—

a. Front and antero-lateral margins thin and cristate . . *carinatus.*

aa. Front and antero-lateral margins thickened . . . . . *rotundifrons.*

Crested Forehead-crab. *Megametope carinatus* (Baker). (ridged).

The front of the carapace is bent down, and is of semicircular shape, with the margin thin. There is a tiny notch near the inner orbital angle, and

Fig. 156.—*Megametope carinatus* (x $1\frac{1}{2}$).

three similar notches on each antero-lateral margin. The upper and lower margins of the hands, and of the last four joints of the walking legs are sharply crested. Length of carapace: 21 mm., or $^{13}/_{16}$in. (S.A.M.)

Smooth Forehead-crab. *Megametope rotundifrons* (M. Edwards). (with a rounded front).

Easily distinguished from the foregoing species by the characters given in the key and by the form of the front, which is roundly subtriangular

in shape, and is longer than in *M. carinatus*, so that it appears to be more declivous: also, the margins of the hands and of the joints of the walking

Fig. 157.—*Megametope rotundifrons* (x 1½).

legs are not crested, but are smooth and rounded; there is no trace of a notch near the inner orbital angles. Length of carapace: 21 mm., or $^{13}/_{16}$in. (S.A.M.)

PSEUDOCARCINUS (M. Edwards).

Giant Crab. *Pseudocarcinus gigas* (Lamarck). (gigantic).

The carapace is convex and swollen, and the front bears four short and thick spiniform teeth. Each of the antero-lateral borders is divided into four somewhat obscure lobes, each of which is furnished with two or three short teeth. The chelipeds are massive and, at least in the male, one is very much larger than the other; the walking legs are rounded, and the upper border of the merus of each is armed with spines. The back of the carapace may be a uniform red in colour, red with yellow spots, or yellow with numerous vermiculate red markings. The palm of the chelae is yellow vermiculated with red, or yellow with the upper surface almost wholly red, or with yellow spots on a red ground. The fingers are for the greater part black. Length of carapace: 279 mm., or 11in. (S.A.M.)

This is one of the largest known crabs of the world, and attains a weight of at least 30lb.; an example has been taken in which the carapace was about sixteen inches in breadth, and the large hand more than seventeen inches in length, measured from the base of the palm to the tip of the immovable finger. As a rule, it is found in deep water, and is apparently not rare in the Great Australian Bight. Some years ago a large specimen was secured on the rocks near Kingston, on the south-eastern coast. The

white flesh of the Giant Crab is highly esteemd as food. Mr. F. A. McNeill writes in the *Australian Encyclopaedia*: "When hauled on board ship these crabs are almost paralysed, owing to the sudden reduction of the great pressure under which they are accustomed to live, and may be handled with

FIG. 158.—*Pseudocarcinus gigas* ($\frac{1}{11}$ nat. size).

impunity. Under natural conditions, however, they must be formidable enemies, armed as they are with huge nippers sufficiently powerful to crush a man's wrist."

Subfamily Actaeinae.

ACTAEA (de Haan).

The small crabs placed in this genus have the carapace elaborately lobulated, and the front usually cleft in the middle. The chelipeds are equal in both sexes. Two species are common in our seas.

a. Carapace ornamented with plain isolated tubercles. Walking legs with elongate, thorn-like tubercles . . . . *peronii.*

aa. Carapace closely covered with confluent tubercles. Walking legs without thorn-like tubercles (sometimes with a few elongate tubercles) . . . . . *calculosa.*

Thorn-legged Crab. *Actaea peronii* (M. Edwards). (personal name).

The carapace is covered with convex, polished, and distinctly separated tubercles. There are four large ones on each of the antero-lateral margins, and the outer surfaces of the wrist and hand bear similar prominent projec-

Fig. 159.—*Actaea peronii* (x $1\frac{1}{4}$).

tions. The fingers are dark brown, short and bluntly pointed, slightly hollowed at the tips. A large example from Port Willunga is illustrated. Length of carapace: 20 mm., or $\frac{3}{4}$in. (S.A.M.)

Fig. 160.—*Actaea calculosa* (x $1\frac{1}{4}$).

Facetted Crab. *Actaea calculosa* (M. Edwards). (gravelly).

The carapace is ornamented with closely confluent tubercles, which are themselves formed of intimately confluent granules: they thus present a

faintly facetted appearance. The antero-lateral margins are four lobed. Similar tubercles to those on the carapace cover the outside of the wrist and hand. A glance at the figures enables one to readily separate this from the foregoing form. Length of carapace: 20 mm., or $\frac{3}{4}$in. (S.A.M.)

Subfamily Oziinae.

OZIUS (Leach).

Reef Crab. *Ozius truncatus* (M. Edwards). (truncate).

The carapace is flattened above and bears small but distinct tubercles on the frontal region and antero-lateral parts; the pterygostomian regions are roughened with granules. The front is wide and slightly sinuate, and the antero-lateral margins are cut into four broad lobes, or teeth. One or other of the hands is much larger than its fellow, markedly so in old examples. In the last named the large chela is much more developed

Fig. 161.—*Ozius truncatus* (nat. size).

than in the male illustrated, and is sometimes as long as the carapace is wide. The fingers are always brownish-black, tipped with horn colour, but the carapace and legs are variable in colouration, ranging from very dark brown or olivaceous, densely mottled with brown, to pale olivaceous with a few brown dots. Usually the hinder part of the carapace is paler than the anterior half. Length of carapace: 50 mm., or 2in. (S.A.M.)

This crab is exceedingly common on the rocky parts of our coasts. It often feigns death when touched, remaining perfectly quiet with the hinder

legs extended backwards in an unnatural position. Fishermen who set nets where the species is abundant sometimes find many specimens entangled in their nets in the evenings. If time presses, the nets may be rolled up without removing the crabs; in such case the mesh is chewed and torn by the crustaceans as they attempt to escape.

Subfamily Pilumninae.

Five genera are represented in South Australia:—

a. Orbits visible in dorsal view; the antero-lateral margins of the carapace do not form an unbroken curve with the frontal margin.

b. Carapace naked, or with a few hairs only . . . . . *Heteropanope.*

bb. Carapace usually well clothed with long hairs or pubescence, or with both long and short hairs.

c. Antero-lateral margins of carapace cut into teeth, which are often spiniform.

d. Carapace transversely oval, flattish, or moderately convex . . . . . *Pilumnus.*

dd. Carapace more subcircular, strongly convex . . . . *Actumnus.*

cc. Antero-lateral margins of carapace obscurely divided into lobes . . . . . *Heteropilumnus.*

aa. In dorsal view the orbits are concealed beneath the projecting anterior margin of the carapace; the antero-lateral margins form an unbroken curve with this anterior margin . . . . . *Cryptocoeloma.*

In dealing with crabs of this subfamily it is almost always necessary to remove some of the hairy covering in order to examine the underlying characters.

HETEROPANOPE (Stimpson).

Smooth-handed Crab. *Heteropanope serratifrons* (Kinahan). (with serrated front).

The carapace is moderately convex, with the regions fairly well defined; the front is divided into two subtriangular, granulated lobes. Each antero-lateral border is cut into four tooth-like lobes with granulated edges; the first tooth is confluent with the outer orbital angle. There are but a few hairs on the carapace. The hands are nearly smooth, and the wrist has an acute spine at its antero-internal angle; the ambulatory legs are moderately hairy. In colour the crab is brownish-purple above, the chelipeds are

yellowish below, and the fingers are black, tipped with pale brown. Length of carapace: 25 mm., or 1in. (S.A.M.)

Fig. 162.—*Heteropanope serratifrons* (nat. size).

This crab was at one time common under stones on the sandy beaches at Osborne; as a result of dredging operations the beaches are now buried under fine mud.

PILUMNUS (Leach).

The carapace and legs are generally covered, more or less densely, with hair, a character which has led to the popular name "Hairy-crabs." The antero-lateral margins are cut into teeth which are often spine-like. Six species have been taken in our waters: the following key is somewhat deceptive if one attempts to identify dried examples which have been denuded of their clothing, but with fresh specimens, or those preserved in fluid, identification is easy.

a. Carapace densely covered with very short hairs.

b. Antero-lateral teeth of carapace each capped with a cluster of granules; without red, bead-like granules showing through pubescence . . . . . *monilifer.*

bb. Antero-lateral teeth of carapace not capped with a cluster of granules; with red, bead-like granules showing through pubescence . . . . . *rufopunctatus.*

aa. Carapace clothed with long hairs, or with short pubescence mixed with some long hairs.

c. More than half of outer surface of larger hand smooth and without hairs, at least in the male *fissifrons.*

cc. More than half, or whole, of outer surface of larger hand rough.

d. Antero-lateral projections of carapace lobiform, not spine-tipped . . . . . *semilanatus.*

dd. Antero-lateral projections of carapace spine-like or each tipped with a spine.

e. Carapace with long, slender, and simple antero-lateral spines . . . . . *acer.*

ee. Carapace with shorter antero-lateral spines which often bear spinules on the slopes . . *tomentosus.*

Beaded Hairy-crab. *Pilumnus monilifer* (Haswell). (bearing a necklace).

The front is bilobed with the margins granulate, and there is a tooth at the inner angle of the orbit, the margins of which are granulate. There are small clusters and rows of not very conspicuous tubercles on the anterior

Fig. 163.—*Pilumnus monilifer* (slightly enlarged).

part of the carapace. The antero-lateral margins are cut into four teeth (including the low outer orbital tooth) each of which bears a cluster of granules in the adult. The larger cheliped of mature specimens has prominent granules on the upper part of the palm only, and the lower hand is granulate almost to the lower margin. Length of carapace: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

Red-spotted Hairy-crab. *Pilumnus rufopunctatus* (Stimpson). (with red spots).

A small species which has a short, furry coat, in which are imbedded the few red granules which are responsible for the specific name. The

tubercles of the upper part of the palm are large, but lower they become smaller, and disappear altogether near the inferior margin. Length of carapace: 9 mm., or $^{11}/_{32}$in. (S.A.M.)

Tasselled-crab. *Pilumnus fissifrons* (Stimpson). (with cleft front).

This is a very common little crab on our shores. The animal is clothed with a short tomentum, and there are some tufts of longer, soft hairs on the carapace, and single series of tags on the ambulatory legs. In living specimens these long hairs float upright in the water. The upper surface and legs are dingy brown or dark grey, and the palm of the chelipeds is

Fig. 164.—*Pilumnus fissifrons* (x 2).

whitish or marked with orange at the base of the fingers; the last-named are grey or brownish. Less than half of the outer surface of both hands is covered with pubescence, the infero-distal portions being bare and smooth in the male. The tubercles of the larger palm scarcely extend lower than the margin of the pubescence. Length of carapace: 14 mm., or $^{9}/_{16}$in. (S.A.M.)

Ragged Crab. *Pilumnus semilanatus* (Miers). (half woolly).

Rarely seen in our waters, but has been dredged in the Bight and elsewhere. More than half of the dorsal surface of the carapace is smooth and bare, and there are tufts of long, coarse hairs on the anterior and lateral parts, and four much smaller tufts on the posterior portion. Each anterior-lateral margin is cut into granulated lobes. Both palms are rough all over the outer surface; the tubercles of the larger hand are well spaced, and

those of the smaller hand are in part seriate. The walking legs are thickly margined with hair. Length of carapace: 23 mm., or $^{29}/_{32}$in. (S.A.M.)

Fig. 165.—*Pilumnus semilanatus* (nat. size).

Long-spined Hairy-crab. *Pilumnus acer* (Rathbun). (sharp).

This species is known from only a few specimens. It is distinguished by having the three spines of the antero-lateral margins long and slender,

Fig. 166.—*Pilumnus acer* (after Rathbun, x $1\frac{3}{4}$).

and set in cylindrical bases. There is a slender subhepatic spine (visible in dorsal view) and a similar spine at the outer angle of the orbit. The carapace and legs are clothed with rather long, yellow hairs, not arranged

in tufts. The outer surface of the larger palm is armed with spine-like tubercles, arranged in rows; in the male the lower part of this hand is smooth, but in the female the tubercles extend almost to the lower margin in both palms. There is a patch of hair and blunt tubercles on the upper part of the base of the movable finger of each hand; in the smaller hand one or two of the rows of tubercles are continued for a short distance on to the side of the immovable finger. The upper (or anterior) margins of the merus and carpus of the ambulatory legs are armed with curved spines. Length of carapace: 15.4 mm., or $\frac{5}{8}$in. (S.A.M.)

Common Hairy-crab. *Pilumnus tomentosus* (Latreille). (woolly).

Often taken near shore in company with *P. fissifrons;* these two forms are far more commonly met with in South Australian waters than any other member of the genus. The carapace and legs bear yellow hairs, few of which are arranged in tufts. Each of the antero-lateral teeth of the carapace is spine-tipped, and there are usually spinules or tubercles on their

Fig. 167.—*Pilumnus tomentosus* (nat. size).

slopes; sometimes only traces of these spinules are present, occasionally they are entirely absent. The outer surfaces of the palms of both chelae are covered with conical spines, which in some examples disappear near the lower margin of the larger hand. The walking legs are not armed with curved spines as in the preceding species, but the merus has a small spine at the distal end of the upper edge. Living specimens are usually coated with mud and debris which is entangled in the hairs of the body and legs. Length of carapace: 33 mm., or $1\,^{5}/_{16}$in. (S.A.M.)

ACTUMNUS (Dana).

Two species occur:—

a. Carapace with antero-lateral projections each capped with a small spine. Outer surface of hands with closely-placed tubercles . . . . . *setifer.*

aa. Carapace with prominent, curved antero-lateral spines. Outer surface of hands with more widely separated tubercles, most of which are spine-like . . . . . *kingstoni.*

Short-haired Crab. *Actumnus setifer* (de Haan). (bristly).

The carapace is subglobular, and is densely clothed with a short tomentum; the areolae are convex, and are very distinctly marked. The outer surfaces of the wrist and hand are covered with numerous, closely

Fig. 168.—*Actumnus setifer* (x 2).

set tubercles. The walking legs are clothed above with short pubescence similar to that on the carapace, and in addition are fringed with long hairs. Not uncommon off our coasts. Length of carapace: 14 mm., or $^{9}/_{16}$in. (S.A.M.)

Downy Crab. *Actumnus kingstoni* (Rathbun). (after Kingston, South Australia).

The carapace is moderately convex, and is clothed with soft and rather short hairs; the regional grooves are deep. The outer surfaces of the wrist and hand are hairy, and are armed with spine-like tubercles which are not crowded. The walking legs are clothed with short hairs above, and margined

with longer hairs. This species is known from a single specimen dredged 40 miles west of Kingston. Length of carapace: 14.2 mm., or $^{9}/_{16}$in.

Fig. 169.—*Actumnus kingstoni* (after Rathbun, x 2).

HETEROPILUMNUS (de Man).

Bearded Crab. *Heteropilumnus fimbriatus* (M. Edwards). (fringed).

The carapace is flattened and densely clothed with tomentum anteriorly, less thickly covered posteriorly: the front and antero-lateral margins bear

Fig. 170.—*Heteropilumnus fimbriatus* (x 2½).

a fringe of long silky hairs. The front is cut into two shallow lobes, and the antero-lateral margins are obscurely four-lobed, these features being apparent when the aforementioned marginal hairs are removed. The upper

part of the chelipeds and the margins of the walking legs, are fringed with long hair. The species has been taken in St. Vincent Gulf. Length of carapace: 11 mm., or $^{7}/_{16}$in. (S.A.M.)

In the specimen photographed the hair is removed from one half of the carapace.

CRYPTOCOELOMA (Miers).

False-fronted Crab. *Cryptocoeloma haswelli* (Rathbun). (personal name).

A small species readily recognized by the peculiar formation of the anterior part of the carapace. The true front is bent vertically downwards and, as viewed from above, the apparent front margin of the carapace forms an unbroken curve with the antero-lateral margins, which are extremely obscurely four-lobed; the antero-lateral parts of the carapace are granulate. The apparent front margin and the antero-lateral margins bear a thick fringe of hair, and the chelipeds and legs are furnished with similar clothing. The orbits are not visible in dorsal view, and even when the fringing hairs are removed the eyes are scarcely apparent from above when folded in their sockets. Length of carapace: 8 mm., or $^{5}/_{16}$in. (S.A.M.)

Family GONEPLACIDAE.

There are no striking differences between this and the preceding family. The male apertures are, however, sometimes situate on the sternum, but often the ducts open on the bases of the last pair of legs and pass forward along a groove in the sternum. Three genera are represented.

a. The base of the third segment of the abdomen of the male covers the whole of the space between the bases of the last pair of legs (Subfamily Carcinoplacinae).
b. Carapace subhexagonal, with postero-lateral margins distinctly converging posteriorly .. .. *Carcinoplax.*
bb. Carapace subquadrate, with postero-lateral margins only slightly converging posteriorly .. .. *Litocheira.*
aa. The base of the third segment of the abdomen of the male does not nearly cover the space between the bases of the last pair of legs (Subfamily Rhizopinae) .. .. *Ceratoplax.*

Subfamily Carcinoplacinae.

CARCINOPLAX (M. Edwards).

Four-spined Crab. *Carcinoplax meridionalis* (Rathbun). (southern).

The carapace is very convex from back to front, with a transverse depression in front of the cardiac region, and a similar hollow behind this region. The almost straight front is double-edged. There is a short oblique ridge

near each of the last lateral teeth and also a slightly oblique, low elevation on the hinder part of the branchial regions. Each antero-lateral margin is cut into three teeth, counting the first or orbital tooth, which is blunt; the two following teeth are acute and thorn-like. The chelipeds are stout, and the wrist is armed with a small tooth each at the inner and outer angles.

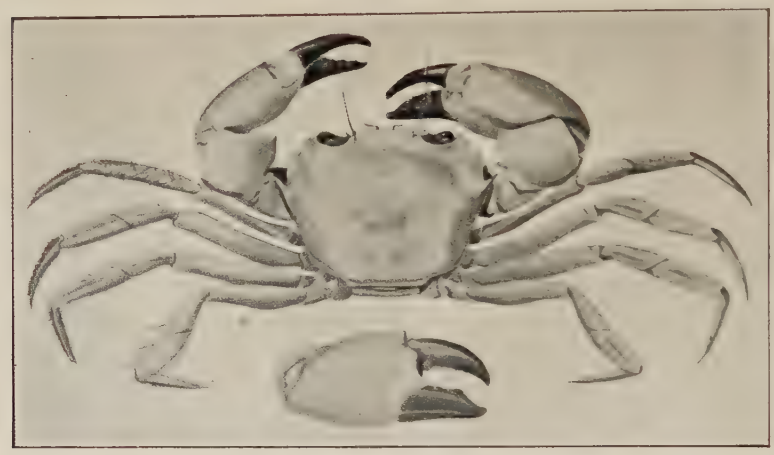


Fig. 171.—*Carcinoplax meridionalis* (after Rathbun, nat. size).

The walking legs are long and slender, with the carpus, propodus, and dactylus sparingly fringed with long hairs; the terminal joint is furnished with marginal stripes of pubescence also. The species occurs off southern Australia, and specimens have recently been secured off the coast of New South Wales. Length of carapace: 22 mm., or $\frac{7}{8}$in. (S.A.M.)

LITOCHEIRA (Kinahan).

a. With one small spine behind orbital angle on each antero-lateral margin . . . . . *bispinosa.*

aa. With a lateral angle, but no spine, behind orbital angle *glabra.*

Two-spined Crab. *Litocheira bispinosa* (Kinahan). (with two spines).

The carapace is smooth, sparsely pitted, marked with two shallow transverse depressions somewhat as in the preceding species, and bears a few hairs; the front is double-edged and slightly arched, sometimes very obscurely bilobed. There is a single, acute, forwardly directed spine on each lateral margin behind the orbital tooth. The chelipeds are robust in the adult, and the inner angle of the wrist is armed with a tooth. The ambulatory legs are moderately long. During life the carapace of this

common little species is mottled with purplish-brown, and the walking legs are irregularly banded with the same colour. Length of carapace: 11 mm., or $^{7}/_{16}$in. (S.A.M.)

Fig. 172.—*Litocheira bispinosa* (x 2).

Angled Crab. *Litocheira glabra* (Baker). (smooth).

May be distinguished from *L. bispinosa* by the following characters:— The front is arched, but is thin and not double edged, and is rather narrower; the antero-lateral margins are slightly arcuate and a little incised towards the lateral angles, which are not furnished with spines. The propodus of the last two pairs of legs is relatively wider. Length of carapace: 8 mm., or $^{5}/_{16}$in. (S.A.M.)

This form may, perhaps, be considered a variety of *L. bispinosa*.

Subfamily Rhizopinae.

CERATOPLAX (Stimpson).

Smooth-edged Crab. *Ceratoplax punctata* (Baker). (punctured, or pitted).

The carapace is broad (one-third as wide again as medianly long), very convex from back to front, smooth, polished, and marked with scattered, distinct pits. The rather narrow front is bent abruptly downwards, and is somewhat indistinctly divided into two lobes. Each antero-lateral margin is evenly arched, practically entire, but marked with three very obscure notches. The postero-lateral margins are slightly concave and subparallel to each other. There are dense fringes of silky hairs on the margins of the chelipeds, legs, and outer maxillipeds, on the front and lateral margins of

the carapace, and on the edges of the terminal segment of the pleon. During life the colour is very pale brown, almost white. Length of carapace: 12 mm., or $^{15}/_{32}$in. (S.A.M.)

This species lives in St. Vincent Gulf; the holotype is illustrated.

Fig. 173.—*Ceratoplax punctata* (x 2).

Family PINNOTHERIDAE.

As only one genus is represented in South Australian waters it is not necessary to outline here the characters of the family as a whole.

PINNOTHERES (Latreille).

The carapace is usually sub-membranaceous or poorly calcified in at least the female; as a rule it is very convex and subcircular in shape, or with the angles rounded. The chelipeds are rather weak, equal in size, and generally more robust than the walking legs. The females live as commensals, or parasites, in bivalve and (more rarely) univalve molluscs, in worms, in the rectum of sea-urchins, in the respiratory trees of Holothurians, etc.; the males are apparently free-swimming in most cases. A European Pea-crab (*P. pisum*) is often found in the large bivalve *Pinna* which, according to ancient belief is:—

> "A stupid wretch, and void of thoughtful care,
> He forms no bait, nor lays the tempting snare;
> But, dull sluggard, boasts a crab his friend,
> Whose busy eyes the coming prey attend."

The "prey" was erroneously presumed to consist of small wandering fish which inadvertently entered the gaping shell of the *Pinna*, and it was supposed that the little crab in such case pricked the tender side of the mollusc, when:—

> "His closing shell the *Pinna* sudden joins,
> And 'twixt the pressing sides the prey confines.
> Thus fed by mutual aid, the friendly pair
> Divide their gains, and all the plunder share."

The only crustacean so far obtained from *Pinna* in our State is a small prawn (*Anchistus inermis*), described in Chapter iv. of this book. Two South Australian species of *Pinnotheres* have been described; in both of these the palp of the outer maxilliped is only two-jointed, the terminal segment, or dactylus, being undeveloped.

a. Found in bivalve molluscs. Carapace roundly subquadrate in shape. Chelipeds not much more robust than the walking legs . . . . . *subglobosa.*

aa. Found in Holothurians and Ascidians. Carapace subcircular in shape. Chelipeds moderately well developed, longer, and more robust than the walking legs in both sexes . . . . . *holothuriensis.*

Swollen Pea-crab. *Pinnotheres subglobosa* (Baker). (partially spherical).

This species is known only from females; in this sex the body is soft and swollen, convex, and depressed anteriorly. The eyes possess very little pigment. A great number of tiny eggs are accommodated under the large and

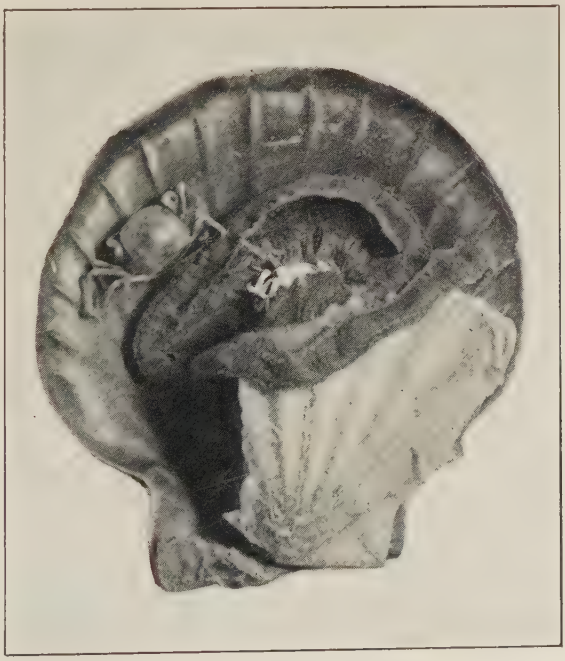


FIG. 174.—*Pinnotheres subglobosa* in *Chlamys bifrons*; portion of shell broken away to show the crabs (nat. size)

cup-like abdomen. The fingers of the weak chelipeds are not much more than one-half as long as the palm, and gape slightly when closed. Length of carapace: 10 mm., or $\frac{3}{8}$in. (S.A.M.)

This Pea-crab is by no means uncommon in from five to ten fathoms in St. Vincent Gulf; it is found in at least three species of bivalves, namely, *Chlamys bifrons*, *Spondylus tenellus*, and *Modiolaria australis*. The female crab lives in the mantle cavity of these molluscs and, as with other species of similar habit, doubtless subsists on matter carried by the flow of water into the mantle cavity. Recent research has shown that the aforementioned European Pea-crab scrapes its hair-fringed chelae over the gills of its bivalve host, and thus collects mucous strings of food material, as they are borne along to feed the mollusc. It has been stated that *P. subglobosa* is apparently "deeper sunk in parasitism than other members of the genus." One example, taken from a *Chlamys*, has a large parasitic Isopod (Epicarid) beneath the abdomen. This recalls the following interesting occurrence:— An investigator, on removing a Pea-crab from a *Spondylus*, discovered that a parasitic barnacle (Rhizocephalid) was attached to the pleon of the crab, and that a parasitic Isopod (Epicarid) was fastened to the barnacle. In this remarkable case we have a tiny, malformed Isopod feeding upon a degenerate barnacle, which in turn is drawing its nourishment from a soft-shelled little crab which relies upon a mollusc for shelter and food.

Striped Pea-crab. *Pinnotheres holothuriensis* (Baker). (after Holothurian).

Both sexes of this species have been taken. The shape of the convex carapace and the relatively larger chelipeds distinguish it from the preceding form. Also, the carapace is firmer, the fingers of the hands are nearly

Fig. 175.—*Pinnotheres holothuriensis* (after Baker, x 2).

as long as the palm and do not gape when closed, and the eyes are fairly well pigmented. The carapace is marked with dark streaks as shown in the figure. Length of carapace: 10 mm., or $\frac{3}{8}$in. (S.A.M.)

"This crab is able to swim, and probably does not spend all its time within the host." Examples have been taken in from five to twelve fathoms in St. Vincent Gulf from Holothurians and Ascidians; the variety living in the lastnamed is very much smaller than that found in the Holothurians. A specimen from Edithburgh has a parasitic barnacle beneath the abdomen.

Family GRAPSIDAE.

In the crabs referred to this family the front is very broad and the carapace, as a rule, is quadrilateral in shape. The mouth frame is square, and there is usually a marked gap between the outer maxillipeds. The palp of the last-named articulates either at the middle of the front edge or at the antero-external angle of the merus. The male ducts open on the sternum. The numerous species are found under rocks and debris on beaches, on reefs, in estuaries, in the open sea, or in burrows on the shore. The subfamilies are separated thus:—

a. The first antennae fold beneath the front in the usual manner, and are not then visible from above.
  b. An oblique, hairy ridge on the external surface of the outer maxillipeds . . . . . SESARMINAE.
  bb. No oblique hairy ridge on the external surface of the outer maxillipeds.
    c. The lower edge of the orbit runs downwards towards the mouth frame . . . . . GRAPSINAE.
    cc. The lower edge of the orbit does not run downwards to the mouth frame, but is supplemented by a suborbital crest . . . . . VARUNINAE.
aa. The first antennae are placed in deep clefts in the front of the carapace and are visible in dorsal view . . . . PLAGUSIINAE.

Subfamily Sesarminae.

The species are readily recognized by the presence of the hairy ridge on the third maxillipeds. Also, the pterygostomian regions (or side-walls of the carapace) are finely marked with granules, and furnished with curious hairs, or are provided with hairs only.

Respiration.—The crabs of this subfamily may leave their natural element for long periods; in such case, as the vitiated water is expelled from the gill-chambers it spreads over the spongy pterygostomian areas, and thus picks up fresh oxygen. The appendages of the outer maxillipeds (epipods), working in the gill-cavity entrance at the base of the chelipeds then drive the water back to the gills. The hair ridges of the external maxillipeds meet to form a triangular barrier which prevents the recharged water from entering the mouth.

Our genera may be distinguished as follows:—

a. Antero-lateral margins not cut into teeth . . . . . *Cyclograpsus.*
aa. Antero-lateral margins cut into teeth.
  b. Body thick and front very declivous. Last abdominal segment of female less than twice as wide as long. *Helice.*
  bb. Body more depressed, with front not markedly declivous. Last abdominal segment of female at least twice as wide as medial length . . . . . *Paragrapsus.*

CYCLOGRAPSUS (M. Edwards).

Smooth Shore-crab. *Cyclograpsus audouinii* (M. Edwards). (personal name).

The carapace is about four-fifths as long as broad, smooth with a few punctures and eight large shallow pits, the latter not distinct in juveniles; the frontal, orbital, and hepatic regions are finely granulate. The lateral and frontal edges of the carapace are raised and finely beaded; the front is convex, very slightly bi- or quadrilobate, and about one-third the greatest width of the carapace. The chelae are massive in large males, and sometimes one is considerably larger than the other. The hand has a swollen crest on the inner face, this elevation being granulate in at least the adults; the granules are sometimes thorn-like. There is considerable variation in

Fig. 176.—*Cyclograpsus audouinii* (nat. size).

the colour: in specimens from the open sea or on sandy beaches the carapace is usually brownish-purple, very often darker anteriorly than on the hinder part; the legs are brownish-purple, marked with paler colour, and the chelae are pale on the outer and inner surfaces. Examples taken from mud-flats and reefs are often mottled with purple, dark grey, or brownish-grey. Length of carapace: 30 mm., or $1^{3}/_{16}$in. (S.A.M.)

The entire antero-lateral margins of the carapace enable one to readily separate this from our other Grapsid crabs. The Smooth Shore-crab is commonly taken by dredging in shallow water, and is also exceedingly plentiful on our beaches and reefs, estuarine flats, etc. It will live for a remarkably long period away from water; a South Australian biologist once collected a series of specimens and on reaching his home, eight miles from the coast, placed them in a receptacle from which they all managed to

escape. Months later he encountered one of the crabs walking along the hall of his residence; he surmises that the crustacean retreated to a damp spot (possibly the bathroom) in order to replace moisture lost through evaporation, and at last having tired of a fluviatile existence, was endeavouring to make its way back to the sea.

HELICE (de Haan).

Mud Crab. *Helice haswellianus* (Whitelegge). (personal name).

The carapace is strongly convex in both directions, particularly so fore and aft, owing to the front being strongly bent down. Each antero-lateral margin is cut by a small but distinct incision behind the orbital tooth. The front is obscurely quadrilobate. The hands bear a low crest on the upper and lower margins, and a swollen ridge on the inner face; they are of

Fig. 177.—*Helice haswellianus* (slightly enlarged).

moderate size and finely granulate in the female, but become swollen and massive in the old males, with a granulate tumidity on the inner face. An adult male is illustrated. During life the back and legs are olivaceous or dark slaty-grey, while the large chelipeds of adult males are yellow or orange. Length of carapace: 19 mm., or ¾in. (S.A.M.)

The Mud Crab is common on estuarine flats, where it lives in burrows in the damp mud; it is plentiful in and around the mangroves lining the Port River, and is there sometimes found at a considerable distance from the water. The species also burrows in the banks of the River Murray near the mouth.

Numbers of these crabs were installed in a glass tank containing a quantity of moist mud in order to watch their method of excavating the burrows. Before commencing this work a crab pushes the terminal parts of the

walking legs into the mud, moving the hinder part of the body up and down while doing so. Mud is then pushed outwards with the chelae, and thus a shallow depression is formed. Soon the crab turns on one side or the other, and then continues to excavate with the lowermost chela; as the hole deepens this hand is used as a shovel; it is slowly pushed into the side of the burrow, and a small quantity of earth is scooped out. If the mud is moderately moist, but not sticky, each little mass as excavated is pushed up the side of the oblique shaft towards the entrance with alternate movements of the chelipeds, often assisted by some of the uppermost walking

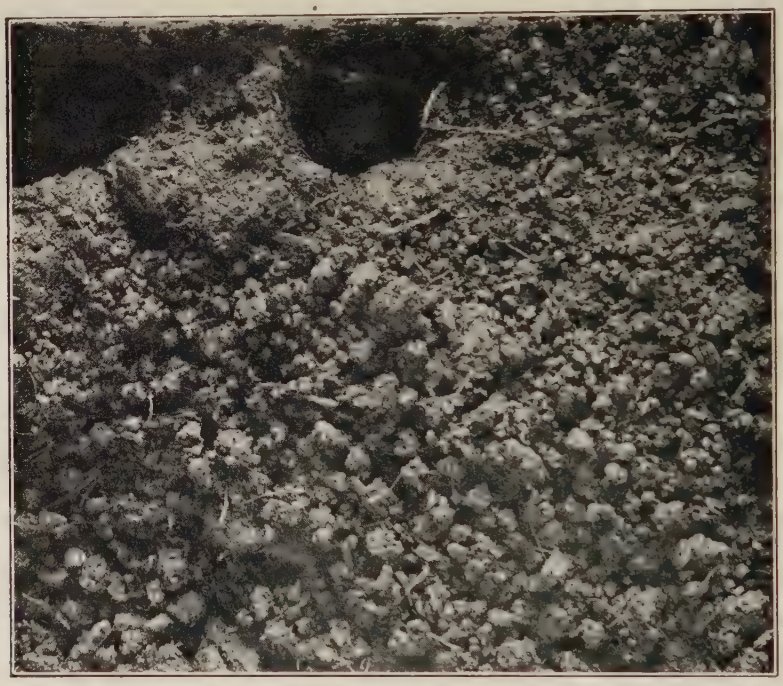


Fig. 178.—Surface of mud in which are burrows of *Helice haswellianus*, showing mud removed by excavation.

legs, the other limbs meanwhile bracing the animal in position. When ground level is reached the mud is pushed away from the mouth of the hole. As the mud is pushed up the slope, and away from the entrance, it tends to assume the form of irregular pellets; in the tank the surface within two days was wholly covered with these little mud-balls (fig. 178). When mud is wet and sticky, it is carried to the surface adhering to the chela with which it was excavated, and there removed with the other hand and allowed to accumulate in an untidy heap. The finger and thumb action is often used in bringing mud up the burrow; the crabs get dirty in the process of excavation, but fastidiously pick fragments from the body and legs with the fingers and push it away with the outside of the hand. Although the

crabs are usually quick and active in their movements, digging operations are slow and deliberate. The burrows usually widen at a short distance from the surface, and often terminate in a rounded chamber from which two or more oblique shafts may lead to outer air (fig. 179.)

Fig. 179.—Section of burrows of *Helice haswellianus* in observation tank.

In the observation tank the crustaceans were fed upon blow-flies, earthworms, etc. Food is held in one chela while portion of it is pulled away with the other; the detached piece is then gripped in the jaws, and a smaller fragment torn off and swallowed.

PARAGRAPSUS (M. Edwards).

The body is depressed, with the front rather prominent and overhanging the epistome in dorsal view. This genus is close to *Chasmagnathus*, but in the last-named the epistome is said to be deep, "projecting beyond the edge of the front."

Mottled Shore-crab. *Paragrapsus gaimardii* (M. Edwards). (personal name).

The subquadrate carapace is more rugose and granulate, with the front less bent down than in the preceding species; the margins are slightly raised

and beaded, and the front is distinctly bilobed. There are two teeth on each antero-lateral margin behind the orbital angle. In the adult male the chelipeds are massive; the upper border of the wrist and palm, and the lower border of the last-named, are obscurely ridged. The outer surface of the palm is finely granulate, and the inner surface is for the greater part granulate, with a swollen ridge which bears a longitudinal row of larger,

Fig. 180.—*Paragrapsus gaimardii* (¾ nat. size).

low tubercles. The upper surface of the body and legs is marked with blotches or spots of dark red, which sometimes coalesce, so that the creature is almost entirely dark red above. Length of carapace: 45 mm., or 1¾in. (S.A.M.)

A common species on muddy bottoms in shallow water; on the Coorong this Shore-crab is said to be destructive to nets set by fishermen.

Subfamily Grapsinae.

The lower border of the orbit curves downwards towards the front corners of the mouth frame. Only two species have been taken in our waters:—

a. Branchial regions with distinct, narrow ridges .. .. *Leptograpsus.*
aa. Branchial regions with very faint, narrow ridges .. .. *Planes.*

LEPTOGRAPSUS (M. Edwards).

Common Shore-crab. *Leptograpsus variegatus* (Fabricius). (varied).

The carapace is roundly subquadrate in shape, with the front crenulate and rather prominent, and with two teeth (which vary in size) behind the prominent orbital tooth. The surface is marked with fine transverse and oblique ridges. In the male the chelipeds are rather massive, in the female they are much smaller. The inner part of the arm is laminate, and toothed

at the distal end of the expanded portion. There is a tooth at the inner angle of the wrist and the upper part of the wrist and hand bears a few tubercles; on the outer surface of the hand, towards the lower edge, is a narrow longitudinal ridge. The merus of the ambulatory legs is expanded and flattened, and the three terminal joints are more or less spiny. The

FIG. 181.—*Leptograpsus variegatus* (½ nat. size).

colouration is variable; South Australian specimens taken from dark grey rocks are of the same colour, while others are dark red and yellow. Length of carapace: 63 mm., or 2½in. (S.A.M.)

This widely distributed crab is the only species of its genus; it is commonly taken on the rugged parts of our seaboard, and displays considerable agility in climbing about the exposed rocks.

PLANES (Leach).

Gulf-weed Crab; Columbus' Crab. *Planes minutus* (Linnaeus). (small).

A much smaller crab than the foregoing, and having the carapace only faintly ridged. Behind the acute orbital angle is a small tooth, which in some specimens is quite obsolete. The chelipeds are somewhat as in the Common Shore-crab, but the narrow ridge on the outer surface of the hand is continued only feebly on to the palm. The colour is stated to be very variable, but the creature is usually mottled or blotched with light greenish-yellow, or pale yellow, on a dark olive-green ground. Length of carapace: 19 mm., or ¾in. (S.A.M.)

A small crab which is found on floating weed almost everywhere in temperate and tropical seas. It has been remarked that "Columbus, finding

this alive on the Sargossa floating in the sea, conceived himself not far from some land, on the first voyage he made on the discoverey of the West Indies." Apparently the species seldom drifts into South Australian

Fig. 182.—*Planes minutus* (after Rathbun, x 2).

waters. The young (*Zoea*) is said to be of minute size when first hatched, with strikingly large eyes and long maxillipeds, while it is heavily pigmented with a network of black lines.

Subfamily Varuninae.

The outer maxillipeds are not furnished with a ridge of hairs as in the Sesarminae, but some of the species spend a considerable part of their lives on land. Two genera are represented:—

a. Front less than half width of carapace, which is broadly suboval in shape. Chelae of adult males without dense fur .. .. *Brachynotus.*

aa. Front about half as wide as carapace, which is subquadrate in shape. Chelae of adult males with some dense, furry clothing .. .. *Eriocheir.*

BRACHYNOTUS (de Haan).

Burrowing Shore-crab. *Brachynotus octodentatus* (M. Edwards). (with eight teeth).

The lateral and anterior portions of the carapace are furnished with low granules, which become indistinct in large specimens; the front is faintly bilobed. There are three teeth on each antero-lateral margin behind the

orbital angle, the last two being very small and often indicated by barely discernible notches. The chelipeds of the female are small with the fingers slender, longer than the palm, and slightly gaping when closed. In the male the chelae become increasingly robust, and the fingers relatively more slender, with age; also, the immovable finger is bent downwards at an angle from the palm, and the fingers of large examples gape more than those of young. In this sex the swollen inner face of the palm is furnished with irregular tubercles. The inner angle of the wrist is armed with a spine, followed (on the inner edge) by one to three more or less distinct spines,

Fig. 183.—*Brachynotus octodentatus* (½ nat. size).

the last of which is usually the most prominent. The colour is olivaceous, mottled or spotted with dark brown. Length of carapace: 50 mm., or 2in. (S.A.M.)

This crab occurs very commonly on the rocky parts of our southern coasts, where it is found in rock-crevices, under debris and stones on estuarine and sea beaches, etc. On the south coast of Kangaroo Island, and on other deserted and exposed portions of our shores, large males, with a carapace two to two and one-half inches in width, live singly in burrows, which they excavate in slightly moist drift sand alongside rocks; these burrows are sometimes situate a hundred yards from the sea. The crustaceans remain in their retreats in the daytime, but at night wander along the beach foraging for food. In early morning, before the wind has smoothed the sand, their tracks may be seen leading from the burrows along the shore, in some cases entering the sea; provided with a lamp one may see the crabs, soon after dark, leaving their retreats and making for the beach.

The species is extremely hardy, and will live for a long period away from moisture. Some specimens collected for Museum purposes were placed alive

this alive on the Sargossa floating in the sea, conceived himself not far from some land, on the first voyage he made on the discoverey of the West Indies." Apparently the species seldom drifts into South Australian

Fig. 182.—*Planes minutus* (after Rathbun, x 2).

waters. The young (*Zoea*) is said to be of minute size when first hatched, with strikingly large eyes and long maxillipeds, while it is heavily pigmented with a network of black lines.

Subfamily Varuninae.

The outer maxillipeds are not furnished with a ridge of hairs as in the Sesarminae, but some of the species spend a considerable part of their lives on land. Two genera are represented:—

a. Front less than half width of carapace, which is broadly suboval in shape. Chelae of adult males without dense fur .. .. *Brachynotus.*

aa. Front about half as wide as carapace, which is subquadrate in shape. Chelae of adult males with some dense, furry clothing .. .. *Eriocheir.*

BRACHYNOTUS (de Haan).

Burrowing Shore-crab. *Brachynotus octodentatus* (M. Edwards). (with eight teeth).

The lateral and anterior portions of the carapace are furnished with low granules, which become indistinct in large specimens; the front is faintly bilobed. There are three teeth on each antero-lateral margin behind the

with large or small white markings, while others have the whole upper surface of the carapace milk-white. Length of carapace: 15 mm., or $^{9}/_{16}$in. (S.A.M.)

Fig. 185.—*Eriocheir spinosus* (x 2).

A common little crab, found on reefs or sheltering under nodules of mud and under stones at low tide.

Subfamily Plagusiinae.

Our one species is easily recognized by the aforementioned deep clefts in the front of the carapace.

PLAGUSIA (Latreille).

Cleft-fronted Shore-crab. *Plagusia chabrus* (Linnaeus). (meaning unknown).

The body and legs are closely covered with rather short hairs; the front has the edge tuberculate, and is armed above with two short, spine-like tubercles. There are three stout, acute teeth on the lateral margins behind

Fig. 186.—*Plagusia chabrus* ($\frac{1}{2}$ nat. size).

the orbital tooth. The chelipeds are massive in the male, much smaller in the female; the wrist and hand bear longitudinal rows of coarse tubercles. The walking legs are ridged, and the anterior margin of the merus of each is armed with teeth or spines. Length of carapace: 73 mm., or 2⅞in. (S.A.M.)

A not uncommon crab on our most exposed coasts.

Family OCYPODIDAE.

The crabs of this family may be separated from those placed in the Grapsidae by the following characters:—The carapace, while often quadrilateral in shape, has the front narrow or not very broad. The eye-stalks are long, at least about one-third the width of the carapace, and the orbits occupy the whole of the anterior margin exclusive of the frontal process. The mouth-frame is usually somewhat narrower anteriorly than posteriorly, and, as a rule, there is no gap between the outer maxillipeds. The coarse palp of the last-named, articulates at or near the antero-external angle of the merus. The male apertures are on the sternum. The Ocypodids are of amphibious habit and are poorly represented in South Australia, only one species having been collected.

HEMIPLAX (Heller).

Sentinel Crab. *Hemiplax latifrons* (Haswell). (with a broad front).

The carapace is about half as wide again as medianly long, with the surface covered with very fine granules. Each lateral border is cut into three teeth (including the orbital tooth) the posterior being much smaller and more acute than the others. The chelipeds are large in the male, and

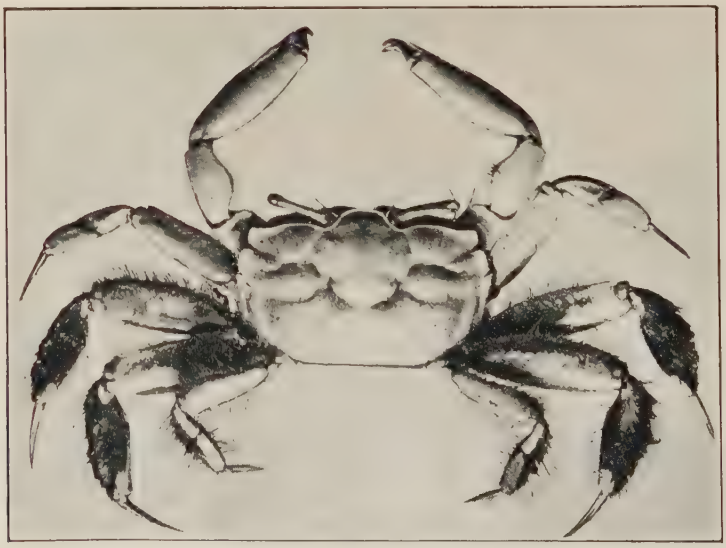


FIG. 187.—*Hemiplax latifrons* (nat. size).

are finely granulate; the upper border of the hand is obsoletely carinate, and there is a low carina on the outer surface near the inferior margin. The immovable finger is bent downwards at an angle from the palm, and the fingers are curved inwards. In the female the chelipeds are much weaker than in the male. The walking legs are fringed with long hairs, and there are dense patches of fur on the merus, carpus, and propodus of at least the second and third pairs. Length of carapace: 19 mm., or $\frac{3}{4}$in. (S.A.M.)

A male dredged in St. Vincent Gulf is illustrated; the species has also been taken from mud banks lining the Port River, but is somewhat rare. The colour of specimens examined soon after death was creamy yellow.

Tribe **OXYSTOMATA.**

The "sharp-mouthed" crabs (*oxys,* sharp, and *stoma,* a mouth) are, as the name implies, separated from all others by the shape of the mouth, which is narrowed towards the front, and produced forwards over the epistome. Figs. 188 and 192 illustrate the triangular shape of the mouth frame of two of our species. The sharp-mouthed crabs are burrowers in sand, and the modification of the mouth parts is directly connected with a specialized mode of respiration correlated with this habit.

Respiration.—It will be remembered that, in the respiratory system already described for the Brachyura, water is drawn in at the bases of the limbs, particularly the chelipeds, passes under the gills, and is carried out of the branchial-cavity at the front corners of the mouth frame. It is evident that if a crab, having an inhalent stream passing directly in at the bases of the chelipeds, were buried continually in mud or sand, the gills would be in great danger of becoming clogged by indrawn sediment; also, the exhalent stream would be impeded by the surrounding sand. The first maxillipeds of the Oxystomata are narrow and elongate, and each has a plate-like process of the inner branch (endopod) which encloses a continuation of the exhalent canal, thus extending the actual orifice to the anterior end of the head, which protrudes just above the surface of the sand when the animals are buried. The inhalent stream is also drawn in at the front instead of entering directly at the bases of the legs, but as this is brought about in different ways in the two families occuring in our waters, the arrangement common to the species of each is described and figured below. The two families are easily separated by these details alone:—

a. Inhalent openings to gill-chambers in front of chelipeds. Vasa deferentia of male open on coxae . . . . . CALAPPIDAE.

aa. Inhalent openings to gill chambers on each side of mouth. Vasa deferentia of male open on sternum LEUCOSIIDAE.

A comparison of figs. 188 and 190 with fig. 192 will enable the position of the respiratory openings of a specimen in hand to be determined.

the orbital tooth. The chelipeds are massive in the male, much smaller in the female; the wrist and hand bear longitudinal rows of coarse tubercles. The walking legs are ridged, and the anterior margin of the merus of each is armed with teeth or spines. Length of carapace: 73 mm., or $2\frac{7}{8}$in. (S.A.M.)

A not uncommon crab on our most exposed coasts.

Family OCYPODIDAE.

The crabs of this family may be separated from those placed in the Grapsidae by the following characters:—The carapace, while often quadrilateral in shape, has the front narrow or not very broad. The eye-stalks are long, at least about one-third the width of the carapace, and the orbits occupy the whole of the anterior margin exclusive of the frontal process. The mouth-frame is usually somewhat narrower anteriorly than posteriorly, and, as a rule, there is no gap between the outer maxillipeds. The coarse palp of the last-named, articulates at or near the antero-external angle of the merus. The male apertures are on the sternum. The Ocypodids are of amphibious habit and are poorly represented in South Australia, only one species having been collected.

HEMIPLAX (Heller).

Sentinel Crab. *Hemiplax latifrons* (Haswell). (with a broad front).

The carapace is about half as wide again as medianly long, with the surface covered with very fine granules. Each lateral border is cut into three teeth (including the orbital tooth) the posterior being much smaller and more acute than the others. The chelipeds are large in the male, and

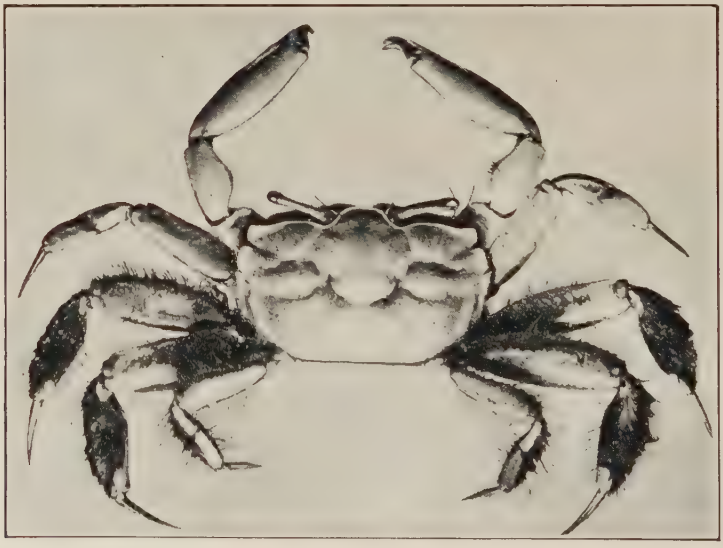


Fig. 187.—*Hemiplax latifrons* (nat. size).

have well-developed fringes. This is undoubtedly due to the fact that these limbs are also continually used as shovels, in which capacity a fringe on the digging blade would be a hindrance. The animals quickly bury themselves at the approach of danger, and are said to "slip themselves under the sand in a moment."

Armed Crab. *Matuta granulosa* (Miers). (with granules).

The carapace is much flattened, granulated towards the lateral margins, and has several well-marked dorsal tubercles. The antero-lateral margins bear blunt teeth, and there is a strong conical spine at the junction of the antero-lateral and postero-lateral margins. The hands bear an external, dentate ridge, and the superior crest is tridentate. The carapace and basal

FIG. 189.—*Matuta granulosa* (slightly reduced).

half of the legs are thickly dotted with red, or are marked with red vermiculations forming small loops or circles; there is a bar of red at the base of each large lateral spine. Length of carapace: 51 mm., or 2in. (S.A.M.).

This species is included in the South Australian fauna on the evidence of a single specimen taken at Port Adelaide; the photograph indicates the markings and characteristic shape.

Subfamily Calappinae.

CALAPPA (Fabricius).

The postero-lateral margins of the carapace are expanded to partly cover the walking legs. The outer maxillipeds do not entirely close the mouth cavern, and the chelipeds are of equal or almost equal size, large with the palm compressed, and armed above with a coarsely dentated, coxcomb-like crest.

More modification as regards the carapace and chelipeds is evidenced in this genus than in *Matuta*. A well-marked channel (fig. 190, a) closed in below by the flat chelipeds, leads from the front of the head to the inhalent opening. The chelipeds, which fit closely together and are very nicely

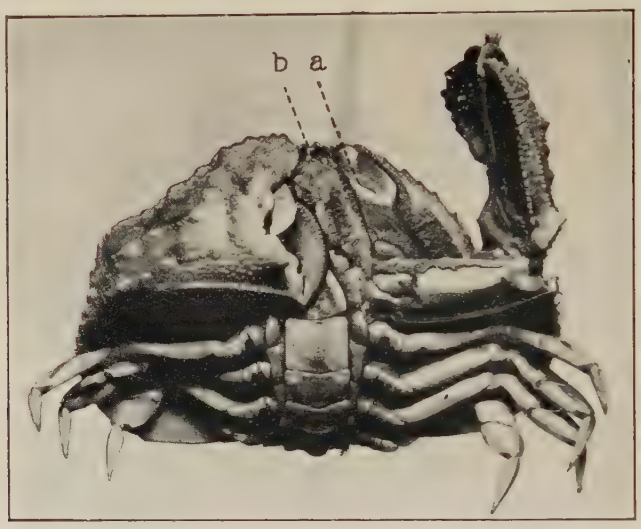


FIG. 190.—Underside of *Calappa hepatica;* a, inhalent channel; b, exhalent opening, closed in below by upper part of palm when chelipeds are folded against body.

moulded to the form of the carapace, assist the endopods of the first maxillipeds in completing the exhalent canals to the tip of the snout (fig. 190, b), in the same way as do the endopods of the outer maxillipeds in the Leucosiidae and in *Matuta*. The outer maxillipeds in *Calappa* are, therefore, not prolonged to the front of the head.

Little Crested-crab. *Calappa depressa* (Miers). (flattened).

The carapace is flattened, not much wider than long, with the surface tuberculate and granulate. There is a median series of tubercles and a

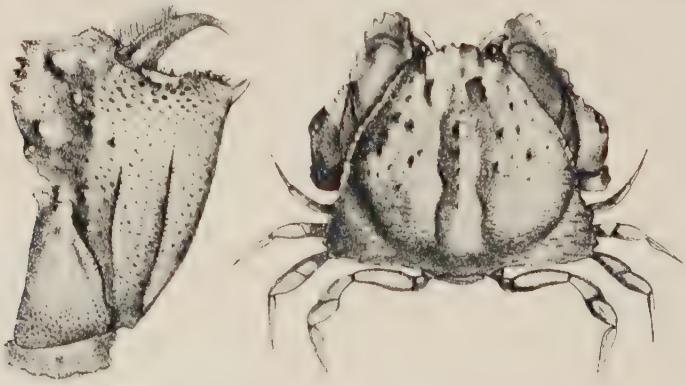


FIG. 191.—*Calappa depressa* (after Miers, x nearly 2).

patch on the hepatic region and the anterior parts of the branchial regions. The front is bifid. Length of carapace: 18.5 mm., or $\frac{3}{4}$in.

The illustration clearly shows the character of the curious chelae of this species, which is remarkable in the genus for its small size.

Family LEUCOSIIDAE.

The channels leading from the front of the head to the gill-openings are more perfect in this family than in the Calappidae. Fig. 192 illustrates the head of a specimen of the Smooth Pebble-crab (*Philyra laevis*) in which the second and third maxillipeds of the right side have been removed, thus exposing the inhalent canal normally covered by the large outer branch of

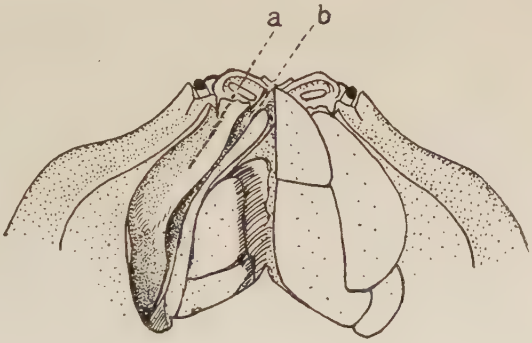


Fig. 192.—Underside of head of *Philyra laevis*: a, inhalent channel; b, exhalent canal.

the third maxillipeds. The palp of the endopod of these maxillipeds is wholly hidden by the triangular merus as in *Matuta*. The male openings are on the sternum. The crabs of this family are small.

a. Dorsal surface of carapace not very uneven.
  b. Carapace produced and expanded at sides so as to partly cover the walking legs . . . . . *Cryptocnemus.*
  bb. Carapace not expanded over walking legs.
    c. Surface of carapace smooth, sometimes covered with bead-like granules, sometimes polished, but with regions rarely at all defined.
      d. Posterior margin of carapace smooth or with a small tooth at each lateral angle. Inner border of merus of outer maxillipeds almost as long as, or longer than, inner edge of ischium.
        e. Front narrow, prominent, and snout-like. Buccal cavern elongate. Exopod of outer maxillipeds narrow, with external margin straight . . . . . *Leucosia.*

ee. Front broader and truncate. Buccal cavern broad. Exopod of outer maxillipeds expanded, with external margin well arched . . . . . *Philyra.*

dd. Posterior margin of carapace with three spines or long processes. Inner border of merus of outer maxillipeds barely two-thirds as long as inner edge of ischium. . . . . *Myra.*

cc. Surface of carapace rather uneven, often with nodules, and with regions usually defined by grooves.

f. Front slightly concave, not quadridentate . . *Ebalia.*

ff. Front with four often tuberculiform lobes, including the anterior orbital angle . . . . *Phlyxia.*

aa. Dorsal surface of carapace granulate and very uneven with large and prominent protuberances . . . . . *Merocryptus.*

Subfamily Leucosiinae.

CRYPTOCNEMUS (Stimpson).

Tortoise-crab. *Cryptocnemus vincentianus* (sp. nov.). (after St. Vincent Gulf).

The carapace is subpentagonal in shape, nearly half as wide again as long, and very convex. There is an obtuse median carina, which forms a low protuberance above the posterior margin. The hepatic angles are prominent and a little obtuse; the antero-lateral margins are concave, forming

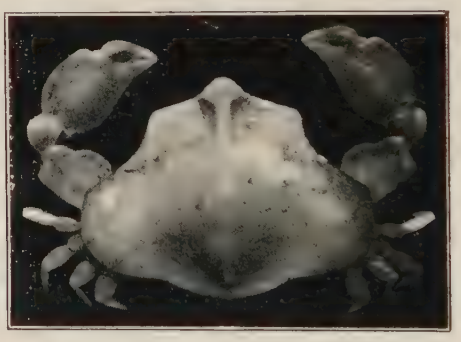


Fig. 193.—*Cryptocnemus vincentianus* (x 4).

an obtuse angle with the evenly rounded postero-lateral margins; the middle part of the posterior margin is convex. The small front is subtriangular, and the orbits are tiny. The hands are swollen and compressed, and the joints of the walking legs bear low crests. The colour during life was ivory-white, with the sides of the carapace and the chelipeds speckled with brown. There are minute punctures, interspersed with some larger pits, on the surface. Length of carapace: 7.25 mm., or $^{9}/_{32}$in. (S.A.M.)

Known only from a single female dredged off the Semaphore.

LEUCOSIA (Fabricius).

The numerous species of this genus have a deep depression in the side-walls of the carapace, just in front of the base of the chelipeds. They are usually highly polished, and are often beautifully coloured, with the chelipeds ornamented with tubercles. Only one representative has been recorded from South Australia.

Painted Pebble-crab. *Leucosia australiensis* (Miers). (Australian).

The antero-lateral margins of the smooth, convex carapace are granulate, and the postero-lateral borders bear a line of tiny granules. The chelipeds are moderately robust, with large tubercles on the arm; the hand is smooth,

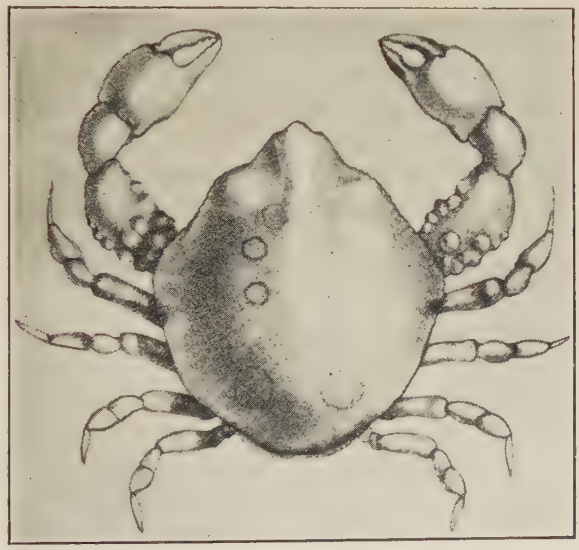


Fig. 194.—*Leucosia australiensis* (after Miers, x $2\frac{1}{4}$).

a little compressed, with entire margins, and the fingers are about as long as the palm, indistinctly toothed and apically inturned. The walking legs are slender and smooth, with the propodi compressed and carinate. The exopod of the outer maxillipeds does not reach to the apex of the merus of the endopod. The colour is stated to be greyish or yellowish, with three white spots on each side of the gastric region of the carapace, which are more or less distinctly annulated with orange and with a pair of circles of the same colour on the back of the branchial regions and an orange-coloured spot on each postero-lateral margin. The bases of the fingers of the chelipeds and the joints of the ambulatory legs are banded with the same colour. Length of carapace: 20 mm., or $^{13}/_{16}$in.

PHILYRA (Leach).

Closely related to *Leucosia*, but differing in having the snout less prominent and broader; the mouth frame is broader, and the exopod of the outer maxillipeds is usually wider, with the external margin curved and the apex rounded. Also, the surface of the carapace is generally dull, not polished. Two species occur fairly commonly, and a third (*P. platycheira* de Haan) has been doubtfully recorded, but as there is a probability that the determination is incorrect the species is omitted.

a. Posterior margin of carapace rounded, without teeth .. *laevis.*

aa. Posterior margin of carapace straight, with a small tooth at each lateral angle .. .. *murrayensis.*

Smooth Pebble-crab. *Philyra laevis* (Bell). (smooth).

The carapace is subcircular, with three slightly angular projections on each side, one over the cheliped, one over the first leg, and a tubercle above the third leg; there is a short ridge on the intestinal region above the smooth, incrassate, and convex posterior margin. The carapace and chelipeds are smooth and dull, with very tiny granules, sometimes with a few larger, scattered, and inconspicuous granules; the walking legs are slender

Fig. 195.—*Philyra laevis* (about nat. size).

and slightly polished. The elongate chelipeds are larger in the adult male than in the female; the hands are somewhat swollen and compressed, with the fingers finely grooved, finely toothed, and as long as the palm in both sexes. The life colouration is dark slaty-grey, more rarely brown, with four small white spots on the dorsum and four tiny white dots in line above the spots; the two posterior lateral angulations and the intestinal ridge are white, as is also the underside of body, legs, and chelipeds. Length of carapace: 25 mm., or 1in. (S.A.M.)

The adults vary in size in different localities. The ridge of the intestinal region may be obsolete in old examples, but in juveniles it is often prominent and produced upwards in the form of a subtriangular tooth; the carapace of the young sometimes bears large scattered granules.

On the north coast of Kangaroo Island this species is abundant, particularly in the Bay of Shoals, which is a shallow, extensive, and protected bay; at low tide a huge area of mud flat is here exposed, and water near shore is nowhere more than a few inches in depth. This tidal flat is the haunt of innumerable forms of life—worms, crustaceans, molluscs, and other invertebrates being present in abundance. In the very shallow inshore water the Pebble-crabs commence their activities as the tide runs out; they probably remain buried in the mud at high water and during rough weather. During mating their courting behaviour is amusing. A male selects a female and moves around her in a clumsy sort of dance; after a time the female, as if fascinated, folds her legs and remains quiescent. The male then seizes his consort with one or the other of his large chelipeds, and bears her off at arm's length, the female remaining all the time quite motionless. If a couple are disturbed during their elopement they at once commence to burrow, the male placing himself immediately behind the female, often with his arms half encircling her. The burrowing occupies only a few seconds. The initial movement is a quick tilting upwards of the front, so that the crab rests in an upright position, supported by the walking legs; then these limbs disappear beneath the mud, and in a moment the hinder part of the body is buried. The chelipeds assist in "working" the animals further down; the motions of these limbs suggest that the creature is clasping silt towards its chest, and then thrusting it away again. When the crab is buried the only visible parts are the front, the eyes, and the blackish second antennae, which by their constant movement apparently assist in keeping the inhalent openings free of sand which washes over the exposed front with every tiny wave.

One of the functions of the long arms is apparent when one observes the creatures searching for food. A crab runs quickly about in the shallow water and is continually pushing its hands down into the soft mud or beneath pebbles, and feeling for edible material. In this way it secures fragments of marine worms, pincer-limbs of Snapping-prawns (*Synalpheus*), and fragments of other burrowing invertebrates.

Large Pebble-crab. *Philyra murrayensis* (Rathbun). (after River Murray).

The subcircular carapace has four small tubercles on each lateral margin; there is a tooth at each end of the straight posterior margin (which is irregularly granulate), and a short, strong tooth on the intestinal region. Both carapace and limbs are dull or very slightly glossy, with low, obscure granules and punctures. The chelipeds are very long in the adult male (which is illustrated), and have the palm swollen and widened apically,

while the immovable finger is set at a slight angle to the palm; in this sex the fingers are shorter than the palm, and the cylindrical merus is longer than the carapace. In the adult female the arm is shorter than the carapace, and the hands are much less elongate, the palm being only as long as, or even shorter than, the fingers. Length of carapace: 30 mm., or $1\,^{3}/_{16}$in. (S.A.M.)

Fig. 196.—*Philyra murrayensis* (nat. size).

This large Pebble-crab is sometimes dredged in company with the preceding species, but is readily separated by the three posterior teeth, the straight hinder margin of the carapace, the very long hands of the male, and so on. The small lateral tubercles of the carapace are much more distinct in some specimens than in others, and the obsolete median carina may bear scattered tubercles.

Subfamily Iliinae.

MYRA (Leach).

The three prominent processes of the hinder margin of the carapace are distinctive.

Beaded Pebble-crab. *Myra mammillaris* (Bell). (a breast-cloth).
The dorsal surface of the oval carapace, and the arms, are studded with tubercles; the three posterior processes are rather short and blunt, and are of about equal size. The chelipeds of the male are large and robust; the

FIG. 197.—*Myra mammillaris* (after Bell, $\frac{2}{3}$ nat. size).

hands are elongate, and the fingers are only half as long as the palm. Length of carapace: 50 mm., or 2in.
This striking species is apparently rare.

Subfamily Ebaliinae.

The bodies of these little crabs resemble rough fragments of stone. For some species the popular name "Nut-crabs" has been proposed.

EBALIA (Leach).

In this and the two following genera the regions of the carapace are generally well defined and tumid, with the elevations often nodular or granulate. In *Ebalia* the pterygostomian regions are swollen, and the posterior margin of the carapace is usually spiny or tuberculate. The front is concave, and the exopod of the outer maxillipeds has the outer margin straight or only slightly curved.

Nut-crab. *Ebalia tuberculosa* (M. Edwards). (with tubercles).
The body, above and below, is closely set with granules, which vary in shape and may be bead-like, flattened, or some of them may be spiniform. The front is moderately prominent, with the anterior margin concave. There is a conical elevation on each hepatic region, and a pair of similar

prominences on each side of the mesogastric region, sometimes with a smaller elevation in between. Each branchial region bears a projection in line with a median cardiac prominence, and there is a stout cone on the intestinal region. The posterior margin is bilobed, the lobes most prominent in the male. In this sex the chelipeds are longer than in the female, with

Fig. 198.—*Ebalia tuberculosa* (x 2).

the hand dilated anteriorly and the fingers much shorter than the palm. Length of carapace: 10 mm., or ⅜in. (S.A.M.)

This species has been dredged in moderately deep water (100 fathoms) off our coast.

PHLYXIA (Bell).

Separated from *Ebalia* by the quadridentate form of the front.

a. Carapace without distinct dorsal tubercles (excepting sometimes one or two obscure tubercles in front of the median posterior spine) and not covered with prominent granules . . . . . *intermedia.*

aa. Carapace with distinct dorsal tubercles, or wholly covered with closely set, prominent granules.

b. Carapace subovate, with low tubercles . . . . . *crassipes.*

bb. Carapace somewhat quadrate, covered with large granules . . . . . *dentifrons.*

Smooth Nut-crab. *Phlyxia intermedia* (Miers). (intermediate).

The carapace of the adult is very finely granulate, with a median spine (variable in size) above the posterior margin, and usually with a low tubercle (sometimes two) in front of this spine. There are three or four

tubercles on each lateral margin, the posterior being the most prominent. The hinder margin is straight or slightly convex, so that the postero-lateral angles are obtusely angular or rounded. In both sexes the chelipeds are elongated and slender, with the fingers about as long as the palm. The hands of adult males, however, become enlarged, with the fingers bent at an angle from the palm; in old examples of this sex (with a carapace 12 mm. to 14 mm. in length) the hand is longer than the carapace. The colour is olivaceous, grey, or almost white, often with darker mottlings. Length of carapace: 14 mm., or $^{9}/_{16}$in. (S.A.M.)

Fig. 199.—*Phlyxia intermedia* (x 2).

A common and variable species. Specimens with the hepatic prominence small, the median posterior spine reduced to a low tooth, and the hinder margin very convex have a superficial resemblance to some of the young examples of *Philyra laevis;* in the last-named, however, the arms are much shorter, the snout less prominent, the outer maxillipeds more arched, etc. Sexually immature specimens commonly have the granules much more prominent than in the adult, the tubercles spiniform, and the posterior median spine acute and often upturned.

Tuberculate Nut-crab. *Phlyxia crassipes* (Bell). (with thickened legs).

Differs from our other species of the genus by having the carapace always with more or less distinct dorsal tubercles, three on the gastric region, two on each branchial region, one on the cardiac region, and one in advance of the median posterior tubercle or spine. Each hepatic region is produced in the form of a subconical tooth; the lateral margins bear three tubercles, the posterior being larger than the others. The hinder margin of

the carapace is straight, convex, or slightly sinuate, with the lateral angles usually obtuse. As in the preceding species, the hands of old males are large. Length of carapace: 12 mm., or $^{15}/_{32}$in. (S.A.M.)

Fig. 200.—*Phlyxia crassipes* (x 2).

Square Nut-crab. *Phlyxia dentifrons* (Miers). (with toothed front).

The hepatic regions are very swollen and prominent, so that the carapace in dorsal view appears somewhat quadrate in shape. The branchial and

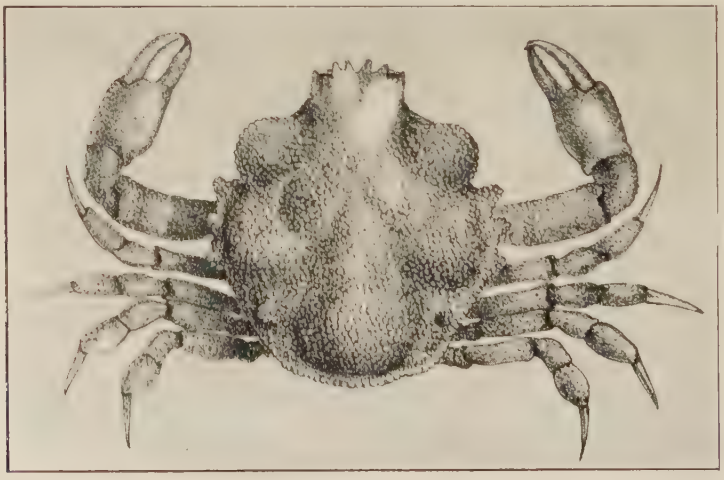


Fig. 201. -*Phlyxia dentifrons* (after Miers, x 4).

intestinal regions are also swollen. On each lateral margin are four spine-like projections; the hinder margin is convex. The body is covered with

closely set, large granules; the chelipeds of the male are moderately elongate, with smaller granules than those of the body. Length of carapace: 10.5 mm., or $^{13}/_{32}$in. (S.A.M.)

This little crab is rather rare in our waters; it has been taken off the Victorian and New South Wales coasts.

MEROCRYPTUS (M. Edwards).

The somewhat rhomboidal carapace is very uneven and tuberculate, concave on the hepatic regions and on the hinder parts of the branchial regions. The outer margin of the exopod of the third maxillipeds is almost straight, and the chelipeds are stout and rather short.

Rough Nut-crab. *Merocryptus lambriformis* (M. Edwards). (like *Lambrus*, another crab).

The carapace is very convex and uneven behind the bifid snout. There are two conical, forwardly directed prominences on the gastric region, and a large protuberance on the cardiac region; the last is dome-shaped

Fig. 202.—*Merocryptus lambriformis* (x 3).

in the adult female (which is illustrated), conical in the male. The hinder margin bears two projections which are most prominent in young males; there are two small spines on the side margins behind the hepatic region and each branchial region has a stout lateral process. The body and legs are covered with closely set, bead-like granules, interspersed with smaller granulations; some of the granules of the legs are sagittate in shape. Length of carapace: 14 mm., or $^{9}/_{16}$in. (S.A.M.)

Date Due

Library Bureau Cat. No. 1137

FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS